The impact of fields force automation technology on coordination : the cases of intervention technicians of France Télécom

Khoubeib Djemai

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Présentée par

Khoubeib DJEMAI

Thèse dirigée par **Marc FAVIER**

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Thèse soutenue publiquement le **« date de soutenance »**,
devant le jury composé de :

M. Marc FAVIER
Professeur, Université de Grenoble (Directeur de thèse)
M. Imed BOUGHZALA
Maître de Conférences HDR, Télécom Ecole de Management (Rapporteur)
M. François-Xavier DE VAUJANY
Professeur, Université Paris-Dauphine (Rapporteur)
M. Thierry DE PALMA
Responsable de l'unité C3P, France Télécom (Examinateur)
Mme Carine DOMINGUEZ-PERY
Professeur, Université de Grenoble (Président)

Université Joseph Fourier / Université Pierre Mendès France / Université Stendhal / Université de Savoie / Grenoble INP

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To my mother and father;
To my sister and brother

SUMMARY

TABLE OF FIGURES

TABLE OF TABLES

TABLE OF BOXES

GENERAL INTRODUCTION

The aim of this introduction is to provide a global overview of the research project. To do so, I have divided it into two parts: the research problem and the research conduct. In the first part, my aim is to reveal the technology under study and the organizational challenges that its use implies. These consequences will take the form of a central research question that can only be answered in relation with three other related research questions in response to the central research question. The second part of this introduction seeks to present the specific research conduct through which I reply to the central problematic under study and its related research questions.

1. The Research Problem

The aim of this first part is to trace the emergence of the research topic and it's major related problematic. More precisely, this part seeks, on one hand, to reveal a new category of technology gaining a wide success in companies today: the mobile business applications (known under M-business) in general and a particular category called Field Force Automation (FFA). On the other hand, the objective of this first part of the introduction is also to show why the FFA technology was chosen among all the other M-business applications.

1.1. Mobile Application in Business: toward the emergence of M-business

First of all, what is a mobile application? In general, a mobile application is a simply a software program integrated within a mobile device, like a PDA or smart phone or mobile phone, allowing for the storage, display of data and their transfer to other applications (Alahuhta, Ahola, & Hakala, 2005). In this way, users, with the difference of use of Internet that requires a fixed space, can do these operations while they are on the move (Gilbert & Han, 2005). However, when users become employees and use these mobile applications in order to accomplish their task when they are away from the corporate company and traveling, the applications, in this case, are called mobile business (M-business) applications (Lee, 2006). Lee (2006) adds that, in spite of fact that their development is backward compared to those developed for customers known

as Mobile Commerce or M-commerce applications, these M-business applications are gaining success in companies and beginning to receive enormous attention.

According to Alag (2006), the development of M-business applications is mainly related to technological advances at the level of networks. To justify that, he provides a useful analysis of the different phases of development of these applications across the three dominant network generations developed to this day (see figure 1). In the first generation, mobile application is used without any network. In fact, they are used in the field by the mobile workers for managing personal information, processing texts or consulting a spreadsheet. Once back at the corporate company they synchronize the mobile device with the PC in order to update the data within the Information system of the organization. As a result, the use of these mobile applications improve individual productivity by avoiding loss of manually re-entering data within a fixed system as well as any errors. In short, this generation of mobile application supports most of the simple, basic work tasks.

In the second generation, the M-business application works in a connected but non-continuous mode in which the data collected from the field can be now directly transferred in real-time to the corporate organization. This generation of M-business provides very basic functionalities like connection, the transfer of data, and generally uses two type of technologies: WAP[1] (Wireless Application Protocol) or the SMS (Short Messaging Service). In short, these M-business applications are only used by the mobile workers for information request or search; they are not suitable for supporting the principal activities of the mobiles workers.

The third generation of mobile applications is characterized by a high-speed access to the network through the development of various new network standards like, the GPRS, EDGE, 3G, etc. In this way, the mobile application can works in connected as well as in continuous mode. This continuity allows, contrary to previous mobile applications, not only support of the mobile workers' secondary tasks of the mobile workers but also affords support of complex ones related directly to the principal activities like CRM, SCM, etc. As a result, and by the use of these types of applications, the efficiency of the organization is enhanced.

[1] A specific protocol developed for the mobile devices allowing the connection of people to mobile Internet.

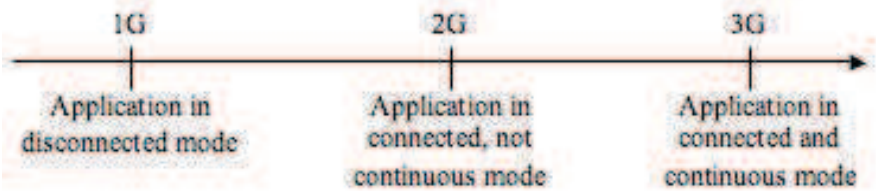


Figure 1. The evolution of the M-Business applications (Alag, 2006)

Through the different stages of development of mobile applications, M-business application begins really as from the second generation in which real-time connection is primordial. In addition the technological development in second and third gives the rise respectively to two types of M-Business applications: Vertical and Horizontal (Paavilainen, 2002) (see the table 1). The main difference between them, as I explained above, is related to the fact that the first type of applications supports secondary tasks whereas the second one supports the principal tasks. More precisely, these applications are defined as follows: vertical applications are "*mobile business applications developed for a massive number of users to improve communication and streamline processes*" (Lee, 2006), while the horizontal ones are defined as "*mobile business applications developed for a specific target group such as field service engineers and sales representatives*" (Lee, 2006). Some examples of these specific users is also provided in table 2.

Vertical mobile applications	**Horizontal mobile applications**
• Mobile e-mail • Mobile bulletin board • Mobile time entry • Mobile calendar • Mobile travel management	• Mobile recruitment tools • Mobile tools for field engineers • Mobile sales reporting • Mobile supply chain tools • Mobile fleet control • Mobile remote control • Mobile job dispatch

Table 1. Examples of vertical and horizontal mobile business applications (Paavilainen, 2002)

Industry	Example of use of the mobile business applications
Hotel	• Embassy Suite: Maintenance and housekeeping crews are equipped with mobile text messaging devices, so the front desk can inform the crew of the location and nature of the repair without physically locating them. • Las Vegas Four Seasons: Customer food orders are wireless transmitted from the poolside to the kitchen. • Carlson hotels: Managers are Pocket PCs to access all of the information they need to manage the properties in real-time.
Hospital & Healthcare	• Johns Hopkins Hospital: Pharmacists use a wireless system for accessing critical information on clinical interventions, medication errors, adverse drug reactions, and prescriptions cost comparisons. • St. Vincent's Hospital: Physicians can retrieve a patient's medical history from the hospital clinical database to their PDA • ePocrates: Healthcare professionals receive drug, herbal, and infections disease information via handheld devices.
Insurance	• Producer Lloyds Insurance: Field agents can access the company's Policy Administration & Service System (PASS and Online Policy Updated System (OPUS).
Government	• Public safety agencies can access federal and state database and file reports.
Manufacture	• General Motors: Workers can receive work instructions wirelessly • Celanese Chemicals Ltd.: Maintenance workers are able to arrange for repair parts and equipments to be brought to the site using wireless Pocket PCs. • Roebuck: Technicians can communicate and order parts directly from their job location instead of first walking back to their truck.
Delivery	• UPS & FedEx: Drivers can access GPS and other important

service	information in real time.
Table 2. Examples of various mobile business applications (Lee, 2006)	

In addition, Lee (2006) reveals that the use of the M-business applications can provide huge business values for the organizations that can be rated at different levels: efficiency, effectiveness and innovation (see table 3).

Efficiency	Reduce business process cycle time
	Capture information electronically
	Enhance connectivity and communication
	Track and surveillance
Effectiveness	Reduce information float
	Access critical information anytime-anywhere
	Increased collaboration
	Alert and m-marketing campaigns
Innovation	Enhance service quality
	React to problems and opportunities anytime-anywhere
	Increase information transparency to improve supply chain
	Localize
Table 3. Values of mobile business applications ((Chen & Nath, 2004) in (Lee, 2006))	

1.2. The Mobile Application under study: Field Force Automation

In general, researchers have predicted that M-business applications will be significant and will dominate the market in the future (Lehmann, Kuhn, & Lehner, 2004). M–Business applications, as I justified in the previous paragraph, are not limited to sales force applications but also support mobile field force workers in the domains of maintenance, repair and operations (Lehmann et al., 2004). More precisely, these mobile field force workers represent the population that can most benefit from mobile technologies (Barnes, 2004; Rodina, Zeimpekis, & Fouskas, 2003). Mobile technologies that support the field force are called Mobile Wireless Field Force Automation (FFA). In 2004, Redman estimated that the number of users of wireless FFA would reach 4 million by 2008 and that the market for wireless FFA would be worth roughly 400 M$

in North America (see figures 2 and 3). In a recently published study by the consulting group Strategic Analytics, it was predicted that wireless FFA will grow by 16% in North America, Western Europe and Asia/Pacific to over $1Billion in 2009.[2]

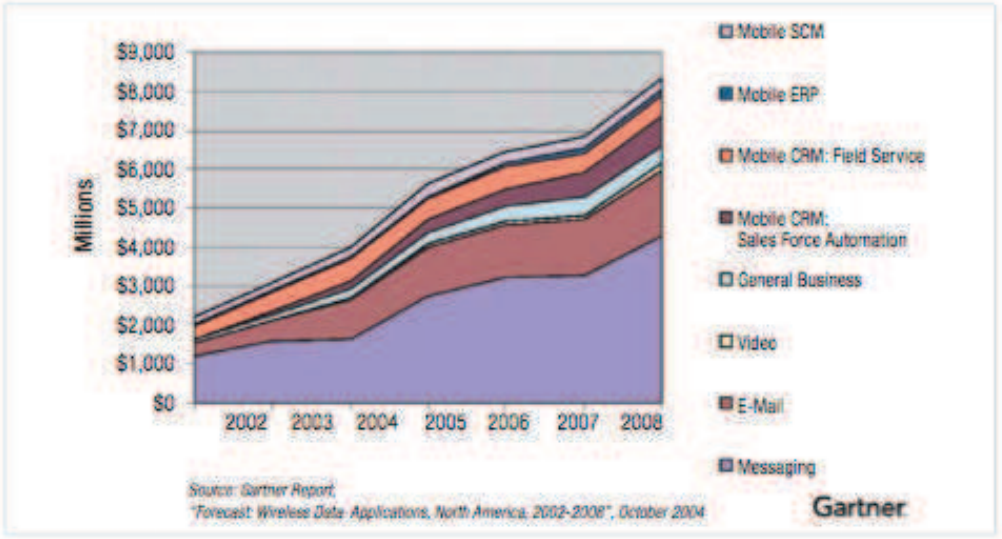


Figure 2. Estimation of the use of wireless data application in North America, 2002-2008

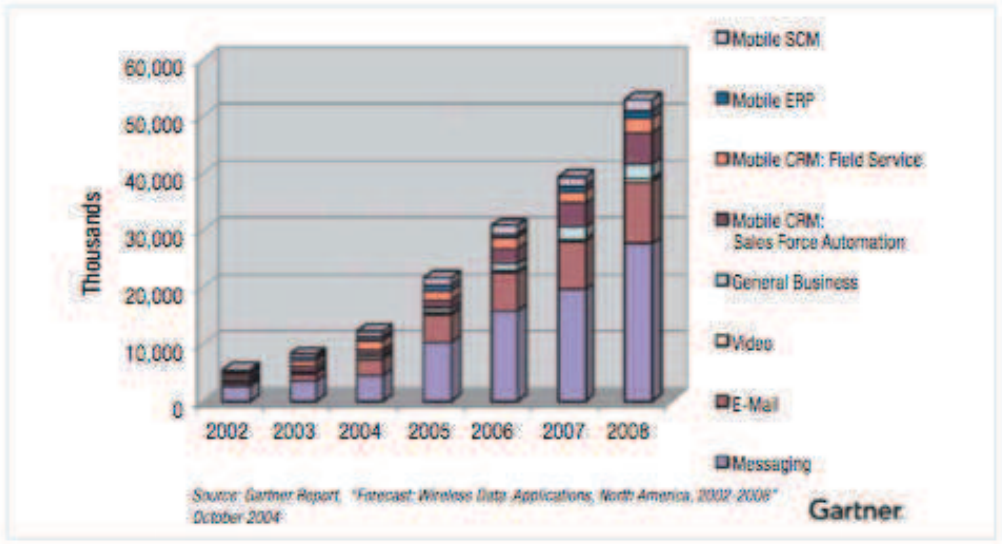


Figure 3. Estimation of the size of Wireless Data Applications markets in North America, 2002-2008

[2] Even if these statistics are not recent, the aim is to show their evolution across time over a long period of time, 6 years, compared to all the others M-business applications.

Through statistics we justified why we had chosen the FFA m-business applications in particular as the main focus of this thesis instead of all the other horizontal ones. This application is defined, as its name suggests, through two dimensions, Field Force (FF) and Automation (A). By Automation, this technology refers to a class of information systems (software and/or hardware) (Gorlenko & Merrick, 2003; Rodina et al., 2003) functioning in real time (Barnes, 2004; Olofsson & Emborg, 2004) and used in order to support and manage (scheduling, supervising and reporting) a field force (Olofsson & Emborg, 2004). More precisely (Rangone & Renga, 2006) defines automation as the collection of data in such a way as to provide mobile employees with all the required information when they are away from the organization and reduce, in this way, the updating time for all the organization's information.

On the other hand, the Field Force (FF) refers to the specific target for which this technology is mainly destined, namely all the employees who work and spend the majority of their time away from their base of operations (Barnes 2004; Barnes et al. 2006; Kornak et al. 2004; Trentham et al. 2008; Yang 2007), are the link between company and customers (Alahuhta et al. 2005), do not carry out any sales activities (Rodina et al. 2003) and spend their time communicating with peers and clients, producing and reviewing documents, identifying information and performing large and collective tasks (Breu et al. 2005).

As a result, several industries utilize and are concerned with field service (Evans 2002; Rodina et al. 2003) such as: building repairs, IT infrastructure, and law enforcement. According to Agnihothri et al. (2002), these industries can be divided into three groups (see figure 4):

- Delivery and collection such as package and mail services and garbage collection,
- Emergency services such as police, fire and ambulance. This group can be further sub-divided into three groups: crisis intervention, protection and surveillance, and investigation and instructions. This is based on urgency, frequency and the number of information exchanges (Bazijanec et al. 2004).
- After sales service such as installation, maintenance and repair.

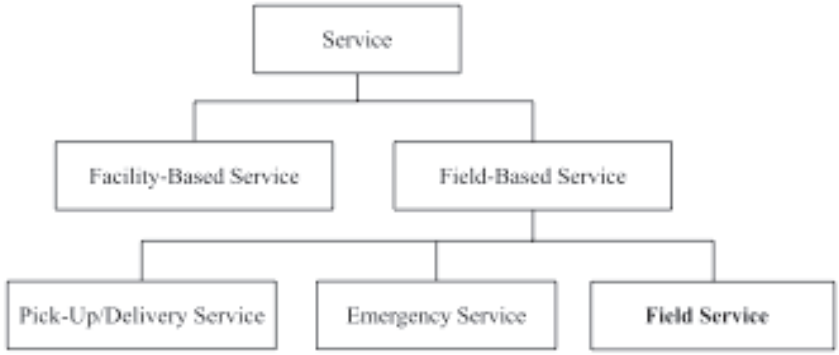


Figure 4. A categorization of services (Agnihothri, Sivasubramaniam, & Simmons, 2002)

Agnihothri et al. (2002) add that these services could be categorized according to "down time". They define it as "*the time between the request for service and completion of the service*". According to this definition, down time can then be divided into response time and on-site time.

Response time is the time between the request for service and the arrival of the technician at the customer location. On-site time is the time spent at the customer site to provide service.

Figure 5. The differences between Down time, Response time and On-site time (adapted from (Agnihothri et al., 2002)

For pick up/delivery activities, service response time and on-site time are not taken into consideration because the service can be scheduled in advance and the on-site time is not significant.

In contrast to pick up/delivery services, for emergency services rapid response time is critical, while on-site time is therefore not taken into consideration after this type of change is implemented.

A third and still different scenario exists, that of sales service response time, for which both response time and on site-time are considered important.

1.3. The Heart of the Matter

Through an extensive analysis of 105 research papers written in relation with M-business applications, (Hosbond & Nielsen, 2005) finds that generally these papers are developed with four perspectives:

- Development conditions perspective: it seeks to study human-machine interaction and technical modeling in order to design a suitable architecture of mobile applications.
- Technological perspective: this perspective broadly covers technical contributions and seeks to understand new technical capabilities in order to best exploit them. This perspective also highlights technical problems and challenges of these emerging wireless innovations.
- Perspective applications: aims at classifying and categorizing the mobile applications according to the market/sectors of their future use.
- Business perspective: is essentially interested at studying the adoption and use of these applications, and also strategic alliances and business models.

In relationship with all Hosbond & Nielsen (2005)'s perspectives, this thesis is developed with reference to the last one: the business perspective. More precisely, this thesis seeks to study the organizational impact of the implementation of the FFA for organization in general. It appears that the use of these new technologies within the field service (the different services developed above) is not without consequence. In fact, research has revealed that the use of FFA within all services poses multiple problems at several levels of organization: technological, organizational, individual and teamwork.

In spite of its recent technological advances, wireless FFA still has several technological problems. Scholl et al. (2007) and Said et al. (2002) cite ergonomic factors. Haugset (2004), and Saidi et al. (2002) highlight the fact that this technology does not respond well to jobsite conditions such as humidity, temperature and rain. For Wiberg (2001) the support of only technical but not complex tasks is problematical. And finally, Scholl et al. (2007) remark upon the lack of synchronization, flexibility, reporting and information organization capacities.

At the individual level, wireless FFA generates several problems for field workers: privacy concerns due to geo-localization technology (Borucki et al. 2005), new

emergent competences (Borucki et al. 2005; Wiberg 2001) and the transfer of tasks and responsibilities, since mobile workers increasingly perform tasks previously attributed to sedentary workers (Lindgren et al. (2005); Borucki et al. (2005).

At the organizational level, and despite the fact that wireless FFA creates a more horizontal and more virtual organization, it does however, reduce the number of employees, and improve process efficiency (Borucki et al. 2005), while also creating several organizational problems:

- *Control challenges:* Lindgren et al. (2005) state that the implementation of wireless FFA in transportation organizations poses two control challenges. First, wireless FFA generates more data to process and implies more time devoted to controlling this data by sedentary workers and managers. Secondly, data generated by this technology omits the integration of contextual factors to help make sound decisions.
- *Alteration of Power:* transparency of the information between "mobile" and "sedentary" provided by wireless FFA can alter the power balance since field workers can remotely access corporate information (Lindgren et al. 2005).
- *Communication challenges:* Yang (2007), and Borucki et al. (2005) state that FFA implies less direct communication between employees. Liu et al. (2007) provide a detailed analysis of these communication challenges, which include *communication direction* (FFA systems that are not based on information coming from the field force), *communication channels* (FFA systems supporting only explicit information and not supporting tacit information) and *communication climate* (relations between managers and field workers). When using Transport Data Management, Lindgren et al. (2005) find that several communication challenges arise between dispatchers and drivers. These include confidentiality issues, trusting the technology to correctly send and receive messages as well as the difficulty of making sense of the information provided.

At the team level, which is the chief concern of this thesis, the use of this technology has profoundly changed traditional means of coordination, since it is more complicated and has had a greater effect on a last category of field service: the customer support service. In fact, Wiberg (2001) and Haugset (2004) find that the use of wireless FFA by technicians has led to the transformation of these means because the technicians no

longer have to go the central station before starting their work, but can start their day working from home and going directly to the customers (see figure 6).

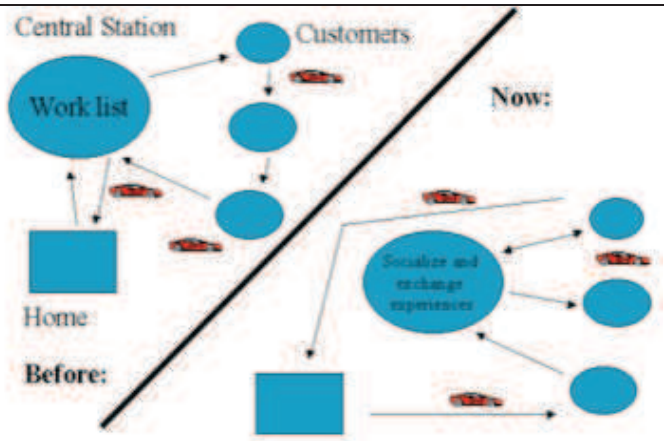


Figure 6. The impact of the FFA on the coordination

This type of change has had important consequences because Wireless FFA eliminates social gathering and community practice, where people exchange information and experiences before going to work (Haugset 2004; Wiberg 2001; Wiberg et al. 1999) and implies the loss both of identity and the desire to maintain group membership (Wiberg et al. 1999). However this community, as justified by Orr (1996), is very important because it is only through a community and its social exchange that people can overcome the problems they face in the field; individual technician efficiency is improved and organization enhanced. This is the key observation that leads to our central research question:

How and why does this technical change (and subsequent coordination change) lead to decreased organizational performance?

- *What is technical change?*
- *Is there another type of change better than technical change?*
- *How and why is this new type of change is better than the technical one?*

2. Research Conduct

To properly reply to these interrogations, I will now present the approach chosen for this thesis. Three steps will be now presented: the theoretical framework, the research strategy and, finally, the global organization of the study.

2.1. The Theoretical Framework and Research Propositions

Our theoretical perspective is based on organizational change and, more precisely, on the change of coordination means. Two major theories of organizational change are developed in line with this: organizational imperatives and technological imperatives, both known as deterministic theories.

The first view of change is developed mainly by Woodward (1980) and Mintzberg (1984) who try to extend the classical organizational theory, highlighting control as the one and only means of coordination, by incorporating informal means of coordination into those relating to the ones developed by the rational theory of organization. They show, in this way, how coordination mechanisms can change according to the changes occurring in technology complexity.

The second and contrary view of change is developed in the contingency theory, which argues that changes in coordination means are only related to context, contingencies and organizational imperatives. In this way, it is only human grasp of the situation and choice that can trigger organizational changes to fit the environment.

In order to avoid this opposition, Markus & Robey (1988) calls for a new perspective called the **emergent perspective** in which organizational change emerges, not from just one side, but from a dynamic interaction between technology and organization (see figure 7).

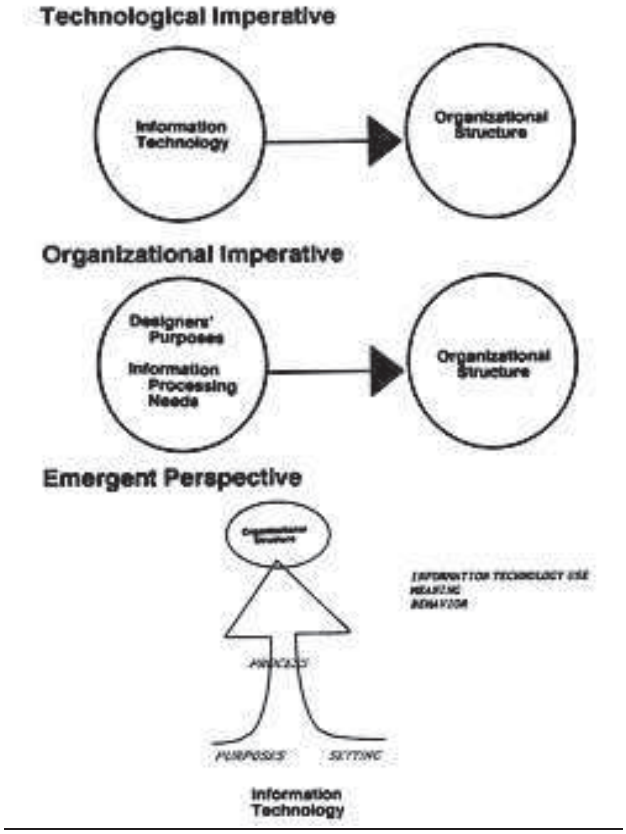


Figure 7. Causal agency (Markus & Robey, 1988)

By comparing the problem as posed above with these three theoretical perspectives on organizational changes, it appears that the problem, as it was stated, matches the first theoretical research stream; technological imperatives developed by Woodward and Mintzberg because it is only through the use of FFA technology that the coordination means can be changed (followed by the corresponding organizational structure). According to the socio-technical perspective, developed by Bostrom & Heinen (1977), this type of change, explains the failure of the use of information systems (IS) in a given organization, because their designer pays no attention to the social dimension when they implement a new information system (see figure 8).

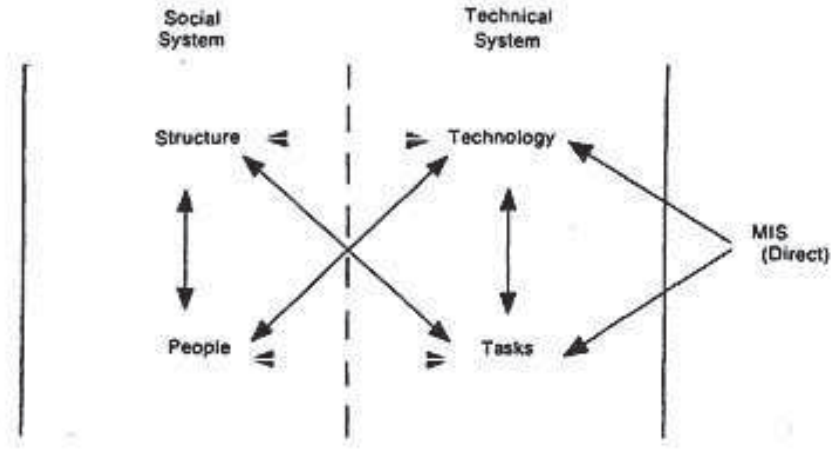


Figure 8. The socio-technical change (Bostrom & Heinen, 1977)

The social factor must be taken into account and the socio-technical perspective has been developed in order to show how and why technical change, in all cases, fails to improve organizational performance, but is rather a source of many organizational problems. This theory also explains that in such cases, socio-technical change is required in order to avoid such problems. On the basis of those assumptions, we propose two fundamental propositions that we aim to verify in this thesis:

Proposition 1: a technical change decreases the performance of the organization
Proposition 2: a socio-technical change increases the performance of the organization

2.2. Research Strategy

At first glance, these two propositions are separate, but in reality the justification of the one depends on the justification of the other in order to demonstrate the power of socio-technical over technical change. A comparative study is thus required to examine these two overlapping cases, which implies comparing the two cases within a single company. As a result, this type of design fits the cross-case study developed by (Yin, 2003), suggesting the study and description of cases separately, followed by their comparison.

France Télécom was selected, as it is a company that fits our problematic and its related design. In fact, this company has implemented wireless FFA technology for their technicians so they can leave directly from home, with a company car, instead of coming to the distributor (central station) in order to get their workload; they are called

the nomadic workers. However, because some of the technicians live near the distributor, they are not allowed to keep the car but have to come to the distributor in order to get the company car and start work from there; these are called sedentary technicians and, in some ways, their previous habit is less altered than for the nomadic technicians.

In this way, the implementation of this technology within this organization provides us with two cases corresponding exactly to what we require: on one hand we have nomadic technicians, a category of workers that has emerged from a situation of technical change, while the sedentary workers represent a category that has emerged from one of socio-technical change.

In this way, this company provided the opportunity to observe two types of parallel evolution in an experimental context corresponding to our study requirements. The observation was undertaken over a three-month period, during which I followed these two types of worker, also belonging to different sites and departments in France: Isère, Savoie and Haute Savoie.

2.3. Research Organization

Because I have applied the design developed by Yin as a research strategy, the organization of this thesis will follow these guidelines (see figure 9). As a result, the two first chapters are concerned with the development of the theory while the two following chapters are concerned with the design of the case and its results.

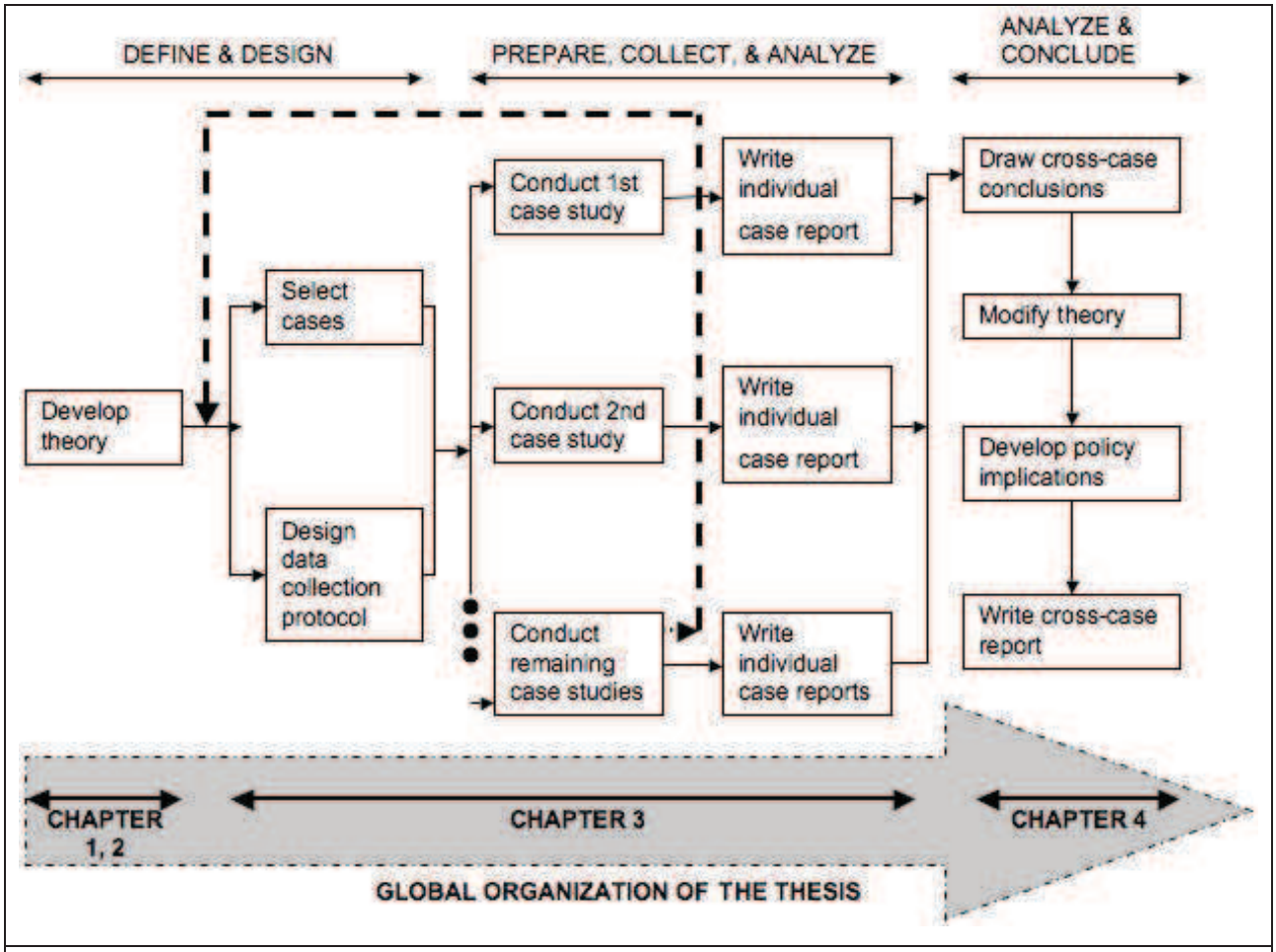


Figure 9. The organization of this thesis according to Yin's case study method.

More precisely, this thesis is organized as follows:

In the first chapter my aim is twofold. First of all, I present and review the existing literature in relation with the technology known as Wireless Field Force Automation, providing a global overview of this technology in order to show the theoretical and practical advancements in the field of FFA technology and its organizational consequences. Secondly, the aim is to show how this technology triggers organizational change by changing coordination means and practices.

In the second chapter, the aim is to show how coordination change has been thought out in the organization theory in general. Two major theories have been studied to this effect: the technological imperative and organizational imperative. However, it appears that neither provides a better explanation of organizational change than the other, because each one focuses on just one aspect of organizational change: technology or

organization. Thus, at the conclusion of this chapter a new model of organizational change will be presented, through which the case will be analyzed.

In chapter three, I will describe the case study methodology applied in this thesis and justify why its use is appropriate in this context. To do so, I followed all the steps recommended by Yin that must be followed by those who wish to apply his methodology.

In chapter four, I present the results from the cross-case analysis from the France Télécom company report. More precisely, using the results of this analysis, I seek to reveal the different mutual adjustments used by the community of technicians, and how and why their disappearance from organizational practice leads to negative performance.

CHAPTER 1. WHAT'S A FIELD FORCE AUTOMATION TECHNOLOGY?

This chapter is organized as follows: the first section presents an overview of FFA by defining FFA, identifying actors in the eco-system, defining functionalities and targets of mobile FFA, and reporting trends in the deployment of FFA solutions. The following section presents a synthesis of the managerial implications of these new technologies.

1. Section 1. An overview of FFA

In this section we provide an overview of the Wireless FFA environment. We start by defining wireless FFA technology, its functionalities, its benefits for organizations, and its Eco-system.

1.1. What is Wireless FFA?

Terms such as "Fully Mobile Wirelessly Connected" (FMWC) or "Mobile Workforce Management" are used to identify Wireless Field Force Automation (FFA). We can use these terms interchangeably. There are also several different definitions of wireless FFA that vary from one author to another. Some of these definitions proposed in the academic literature are:

- FFA is the association between software and hardware, which are used by a specific number of staff, who are responsible to build relationships with customers, maintain expensive corporate and government assets and gather critical data that keep organization running (Rodina et al. 2003).
- FFA is a generic term for mobile applications used in real-time support orders, scheduling, supervising and reporting in the field (Olofsson et al. 2004).
- Wireless FFA is usually used to describe mobile employees, remote from their base of operations, utilizing wireless technologies to perform their specific business tasks (Barnes et al. 2006).
- FFA applications are used by employees such as field service teams, technical teams or more generally, staff that do not carry out any sales activity (Rangone et al. 2006).

- Compared to traditional FFA applications, Wireless FFA offers a substantially increased scope for benefits – particularly through real-time, location independent network connectivity (Barnes, 2004).
- Fully Mobile Wireless Connected (FMWC) is defined as Information and Communication Technologies are assumed to have high potential for improving field operations ((Gorlenko & Merrick, 2003) cited in (Liu, Unsworth, Fidel, & Scholl, 2007)).

Reviewing these definitions highlights the different angles from which the subject is approached. Some focus on technological aspects, others on their target users, and still others on their objectives. We propose the following definition, synthesizing all of these angles:

Wireless FFA is a class of information systems (and/or of software and hardware)[3] functioning in real time[4] applied in order to support and manage (scheduling, supervising and reporting) a field force[5], remote from their base of operations and [6] who do not carry out any sales activities[7].

1.2. What is Wireless FFA's target?

As mentioned by the majority of authors in the last section, and as its name indicates, Wireless FFA is destined for field force utilization. As with FFA, there are multiple terms used to describe a field force. "Mobile workforce", "field workers" or "mobile distributed work" are three such terms that are applied interchangeably. But who, in fact, make up a field force? Several definitions of field force have been proposed in the literature:

- A field force is composed of employees working away from their base of operations while performing their job processes (Barnes et al. 2006).
- A field force is made up of workers that do not carry out any sales activities. Unlike sales force workers, it is difficult to anticipate the work load that will arrive at any

[3] (Gorlenko et al.2003; Rodina et al. 2003)

[4] (Barnes 2004; Olofsson et al. 2004)

[5] (Olofsson, T., & Emborg, M. 2004)

[6] (Barnes 2004)

[7] (Rodina et al. 2003)

given time (Rodina et al. 2003). However, like the sales force team, they must service the customer's needs (Kornak et al. 2004).

- Field technicians are also required to spend a great deal of time away from their offices. Quite often, a field service technician's office is his or her car (Kornak et al. 2004).
- A field force (people working in the field) is the intermediary between a service company and its customers (Alahuhta et al. 2005).
- A field force includes many types of workers and industries performing their work away from their offices and shops (Trentham et al. 2008).
- Field service employees tend to spend a significant part of their time communicating with peers and clients, producing and reviewing documents, identifying information and performing large and collective tasks (Breu et al. 2005).
- Field force actors spend most of their workday away from the office, traveling to and attending to jobs or customer needs in various locations (Yang 2007).
- Mobile Distributed Work is defined by the degree to which an organization's operational and information needs, typically linked to employee activity, are supported in a geographically independent way (Barnes 2004).

The review of these definitions shows that the majority of them focus on the location where field force work occurs, others focus on the performed activity, while still others focus on the linking nature of field force in the organization. We propose the following definition synthesizing all of the aforementioned definitions:

A field force is made up of employees who work and spend the majority of their time away from their base of operations[8], are the link between company and customers[9], do not carry out any sales activities[10] and spend their time communicating with peers and clients, producing and reviewing documents, identifying information and performing large and collective tasks.[11]

[8] (Barnes 2004; Barnes et al. 2006; Kornak et al. 2004; Trentham et al. 2008; Yang 2007)

[9] (Alahuhta et al. 2005)

[10] (Rodina et al. 2003)

[11] (Breu et al. 2005)

1.3. FFA functionalities

The FFA application includes multiple functionalities. For example, Evans (2002) finds that this technology provide nine functionalities:

- Dispatch: Allow mobile employees to be informed about their mission and stay in constant communication with the central office.
- Projects list: allows mobile workers to view their current affectation and those of their colleagues.
- History: access to historical information about the customer and equipment.
- Inspection Form: Allow mobile workers to document the results of the inspection by attaching photos if necessary.
- Proposals: allow mobile workers to prepare proposals to clients for approval before the beginning of the activity.
- Product and Information: Allows mobile employees to access the product and information related to the equipment they will work on.
- Order Processing: Allow mobile employees to check parts availability, order additional parts, and provide invoices.
- Time: Allow mobile employees to schedule their time.
- Training Tools: provide access to online versions of information tools and instruction guides for the repair and support facilities.

On the other hand, Rodina et al. (2003) develops only four functionalities:

- Remote access and update centralized information
- Capture / Register information on-road on the mobile device
- Electronic Transfer of data via wireless connectivity
- Solve customer issues in the field

Olofsson & Emborg (2004) finds six functionalities that technology offers to its users (see figure 9):

- General access: allows access to software platforms via mobile phones or handheld devices on a wireless network (GSM, GPRS, 3G or WLAN).

- Dispatch: visualization of status of work orders and providing mail services: distribution of work can be done at the level of the planner (top-down) or piled up on demand (bottom-up).
- Reports on the work order and workflow: provides the possibility to send work orders to the Office.
- Positioning and e-maps: based on GSM or GPS services, this application allows tracking of the geographical location of employees. This information can be used to optimize the routes and traveling times.
- Optimization and Statistics: optimization algorithms can be used for decision support in planning, resource allocation, and minimization of transportation in real time. The statistics are also important tools in analysis of time and resource utilization.
- Security: a feature that protects the system from unauthorized use of FFA. This feature relies on security procedures, classic login and password.

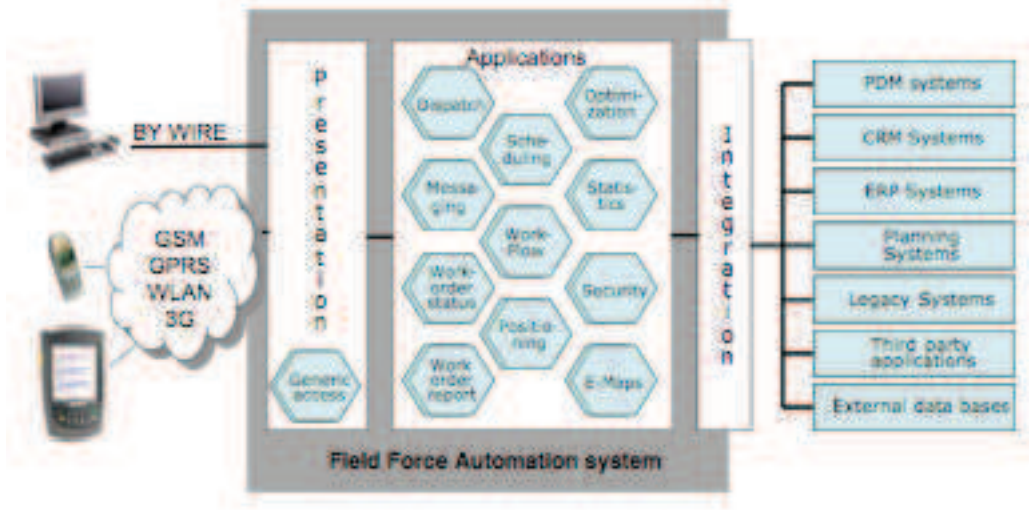


Figure 10. The FFA systems (Olofsson & Emborg, 2004)

Alahuhta et al. (2005) finds only four functionalities in relation with the FFA applications:

- Access to existing information in the back office
- Workflow / order processing: sending requests to the office from mobile devices and control status

- Recording the critical data on the mobile device and synchronization them with enterprise software
- Transferring data by wireless apparatus

Finally, Kornak, Teutloff, & Welin-Berger (2004) finds ten functionalities:

- Access to and update of customer data
- Supporting the billing process and obtaining signatures from customers
- Access to checklists and standardized processes
- Access to product information, manuals and specifications
- Dynamic dispatch, routing, status and planning
- Access to maps, directions, traffic, and time
- Real-time monitoring of the status of work, cost and time
- Identifying the value (add-on) sales and renewal opportunities
- Receiving orders to work in detail at a distance
- Providing mobile office functionalities (e-mail, loads, leaf presence)

The analysis of literature on wireless FFA technology shows the diversity of the proposed functionalities. Some of them are summarized in the table below.

Table 5. Wireless FFA functionalities

Functionalities	**Description**	Evans (2002)	Olofsson et al. (2004)	Kornak et al. (2004)
Dispatching	To allow the assignation of tasks from corporate enterprise	•	•	•
Work order status	To view the current assignation	•	•	•
Service histories	To access customer and equipment information histories	•		•
Inspection forms	To document the results of inspection and attach digital photos	•		
Proposals	To prepare proposals for clients to approve	•		•

	prior to the commencement of large work activities.			
Product and part information	To access information about product and parts.	•	•	•
Order processing	To allow field workers to order parts, consult the available parts and generate invoices.	•	•	•
Time and expense reporting	To allow mobile workers to complete their time and expense reports while in the field and while the information is fresh in their minds.	•		•
Training materials	To access training materials and instructions guide for equipment servicing and repair.	•		
Positioning and E-maps	To allow the real-time tracking of the geographic position of field workers, using GSM or GPS services.		•	•
Optimization	To optimize scheduling, rescheduling, and allocation of resources, minimize transport in real-time.		•	
Statistics	To analyze lead-time and the use of resources.		•	
Mobile office	To access te-mails, instant messaging…		•	•

Reviewing the literature concerning the Wireless FFA functionalities shows that:

- These functionalities can be regrouped into five modules: information/product access, dispatching, location-based-services, optimization and statistics.
- The proposed functionalities are general. However, more specific functionalities are needed because of the differences in tasks from one field worker to another.

1.4. Wireless FFA benefits for organizations

The use of Wireless FFA applications can provide huge benefits for organizations at different levels (Alahuhta et al., 2005). More precisely, Sheng, Nah, & Siau (2005) suggests that the use of these technologies allows to:

- Improve the work processes on-road.
- Receive instantaneous information sharing.
- Improve work efficiency when the mobile worker is on-site.

Evans (2002), on the other hand, identifies multiple other benefits related to the use of this technology for organization:

- Improve productivity by eliminating all inefficient processes related to administration, operations, and communication activities concerning the previous functioning of force field. The author adds that this improvement is not only related to the field workers but also to the coordinators and administrators. In some cases, the function of human coordination can be completely eliminated.
- Reduced service time: the service time can be reduced by eliminating non-value added processes through the automation of the manual processes and the delivery of timely and accurate information, and finally by improving the accuracy of information capture.
- Increase revenue: allowing field workers to do more interventions, customer portfolio is enhanced and revenues are increased.
- Reduce costs: cost reduction is achieved by increased field force productivity and reduction of their consummation of resources, like phone calls, faxes, printers,
- Improve customer satisfaction: customer satisfaction can be improved by the professional image conveyed to the employee through their use of this new technology. In addition, customer satisfaction is increased because the technicians, through the information stored within the mobile application, know customers and equipment history better and are able to resolve more issues and more problems that emerge during the intervention.
- Gain a competitive advantage: these applications may create a differentiation for companies that integrate these technologies as a part of their strategy.

(Rangone & Renga, 2006) find four benefits for the organizations when these applications are used to:

- Provide access to a large amount of information for that the staff when it is needed.
- Minimize the work based on the papers: by automating data collection, internal productivity increases and information becomes more accurate.
- Optimize communication by reducing the time to access to the required service.

Rodina et coll. (2003) identifies that the use of these technologies allows to:

- Improve the productivity of the field force
- Provide adequate customer service
- Improve customer loyalty
- Reduce cost of ownership through the deployment of small terminals and reducing connection costs
- Reduce administrative costs

Finally, Rangone et al. (2007) find that these technologies allow to:

- Reduce time operations and increase employee productivity on the field,
- Reduce business costs, increase revenues and customer satisfaction
- Provide a better control and effective management of the employees.

The details of these benefits with more concrete cases will be provided in the next table.

Table 6. Literature review on the benefits of FFA

Company	Personnel	Application	Functionalities	Objective	Benefits of use
Gas Distribution Company (Rangone & Renga, 2006)	250	WAP integrated with ERP	- Processing business forecasts - Daily planning of the maintenance program for each technician in order to optimize travel time - Fixing appointment customer by adapting real-time availability of the technicians - Treatments of reports on the level of the service	Efficiency	The majority of the appointments are retained (97 % of all the appointments are retained) Improve the productivity of the technicians (increased by 33%) and the workers at the back office by 100% Reduce the waiting time for maintenance Reduce inventories of raw materials through better planning of the warehouse located in the car (by 65%) Reduce the number of building dedicated for the customer service and the warehousing in general

Delta Utility Services (Barnes, Scornavacca, & Innes, 2006)	350	Remote access to geographical information system	Remote support of the teams that could access to the GIS data in real time through their laptops	Efficiency and accuracy	Rich GIS data Integrating the work of the remote employees Access to accurate and real-time data Reduce data entry Improve customer service
Turners Auctions (Barnes et al., 2006)	200	Vehicle inspection	Data collection Photo storage	Efficiency and increase the level of the service provided to the customer	Accuracy and data collection in real-time Improve staff productivity Reduce data entry Improve customer service Reduce overhead competitive advantage
One source (Barnes, 2004)	150	Mobile dispatch system	Allocation of work remotely Bar-code scan of parts	Increase productivity and the level of service	Improve the productivity of the field workers Improve the customer service Reduce costs Improve data accuracy Better management control

Green Acres (Barnes, 2004)	600	Mobile job management system	Allocation of the work and remote management Customer relationship with management	Better customer service	Improve the productivity of the field force Improve the customer service Shorten the response time Reduce costs, for example the telephone charges
Case A (Barnes et al., 2006)	NA	Dispatch mobile service	Visual representation of the work of the real-time location of each worker	Response time and roadside productivity	Connectivity: improving the link between the back and the front office and allow a real-time communication between the two entities Knowledge of the location: the GOS technology allows allocating and monitoring these employees in real-time. Flexibility: allows the field workers to be more flexible regarding the allocation of the work Ubiquity: perform the work while being in the move Interactivity: sharing the information with other external sources. Efficiency: increase the response type and
Case B (Barnes et al., 2006)	NA	FFA system	Task management and planning	More flexibility in the scheduling and daily management of workload and job allocation	

					the productivity of the field workers.
Nuon (Brodt & Verburg, 2007)	343	Smart allocation system	Distribution and allocation of the various assignments by taking into account different dimensions like the skill and clearance of the employees, location…	Reduces response time to comply with regulations without reducing the safety of the employees	Greater efficiency and quality of the maintenance of the electronic network, maximize the safety in fixing breakdowns and increasing the customer satisfaction. Centralization of the information allows building a history of the intervention and reducing the time for searching those information. Improving response time has a great impact on the quality of the network.
Customs Agency (Brodt & Verburg, 2007)	5500	Mobile field force	Digital dispatch station	Decreases the time of wait and travel	Improve the control and the efficiency of the work process Relax monitoring task for distributed teams Reduce disruption to the customer logistics Improve the motivation of the employees

Emergency Medical services (Brodt & Verburg, 2007)	70	Mobile emergency response time	Digital dispatch station in the control center Mobile fleet management application	Complying with regulation regarding documentation and response times	Better compliance with regulatory requirements Positive effect on the company image

1.5. The Wireless FFA Eco-system

The eco-system for wireless FFA consists of software vendors, hardware and infrastructure vendors, and services providers and transport, as illustrated in the figure below.

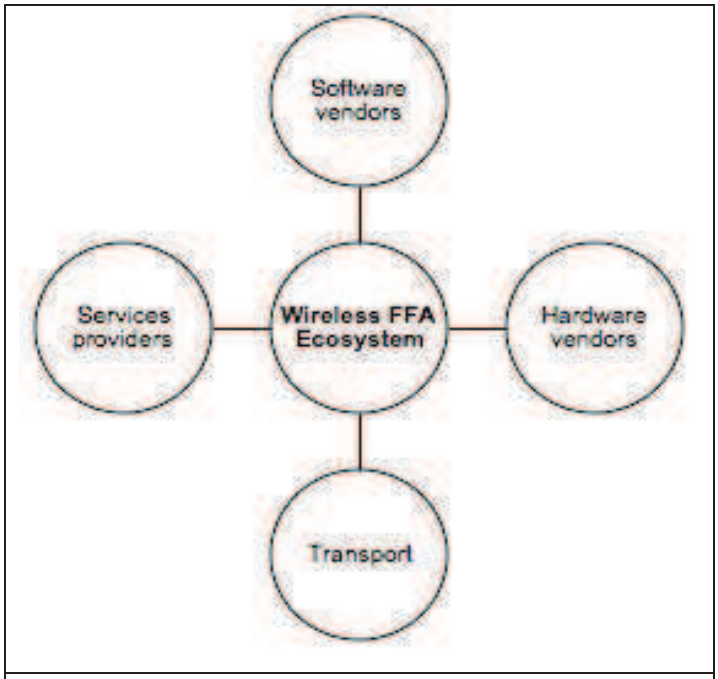


Figure 11. Wireless FFA Eco-system

Software vendors are represented by FFA providers, mobile Platform/OS providers and mobile middleware providers.

- ***FFA application providers*** are the core actors in the FFA eco-system. These actors develop software for the automation of the field force work.
- Two major ***Operating Systems/Platforms*** currently exist on the market, Palm (OS) and Microsoft Windows OS (Mariga, 2003). The main difference between these OS is that Palm OS is suited for individual use while the Microsoft OS is better suited to business applications[12].

[12] For a detailed explanation of the differences between the existing Operating Systems, refer to Mariga's 2003 study.

Mobile middleware providers **provide software applications for remote management of mobile devices. The actual middleware solution provides synchronization, network control, optimization of data, and securities applications[13] (Sabat, 2002).**

Hardware vendors include two major actors, device manufacturers and Back-up equipment manufacturers.

- ***Device Manufacturers*** provide create platforms by which users access wireless applications, including notebook computers, mobile phones, Personal Digital Assistants (PDAs), smart phones, and other wireless communication devices.
- ***Back-end/Equipment manufacturers*** provides the tools physical network necessary for delivering wireless or mobile services.

Service Providers provide build end-to-end FFA solutions and permit the integration of mobile applications into existing solutions.

Transport actors are the telecom operators that who permit the transmission of data between the sending and receiving terminal devices.

The table below provides some examples of current actors viewed existing in the FFA French FFA Market.

Table 7. Examples of Wireless FFA actors

Software vendors	**Services**	**Hardware vendors**	**Transport**
Core application	IBM	Device	Orange
Tech4Field	Devoteam	manufacturers	SFR
Prylos Sc	Nomadvance	Motorola	Bouygues Telecom
Delia Systems	Nomadvantage	Nokia	
	Devoteam	BlackberryRIM	
Middleware	KNK		
Telelogos	ATOS Origin	Equipment vendors	
Sparus		manufacturers	
		Ericsson	
Platform/OS		Alcatel	
Microsoft OS		Siemens	
Palm OS			

[13] For a more detailed explanation of middleware providers/applications, refer to Sabat's (2002) study.

In 2009, Strategic Analytics estimates that:

- Wireless FFA market will reach the $2.5 Billion in North America and Western Europe.
- Industrial expertise and IT skills will remain key selling points in the Wireless FFA market.
- Network transport remains a neglected actor in the Wireless FFA market.
- Integration and clients' devices remain major cost components and are indeed expected to account for nearly 50 percent of the wireless FFA ecosystem in five years.

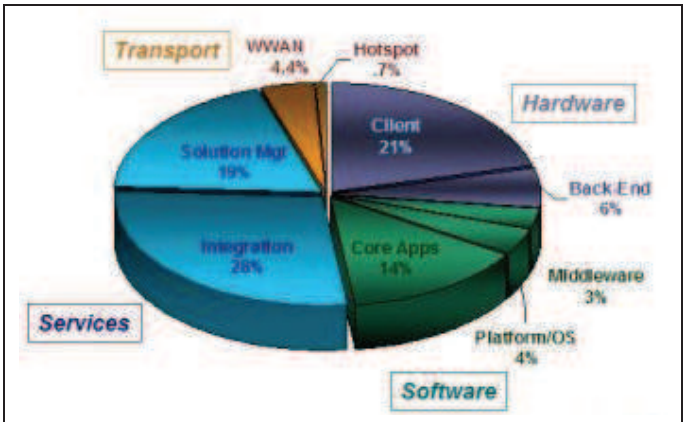


Figure 12. Wireless FFA Ecosystem in N. America & W. Europe (Source: Strategy Analytics)

2. Section 2 the managerial implications of the FFA

Our review shows that globally, FFA research can be categorized into five classes that attempt to answer just the five following four-research questions, as follows:

- What are the precursors for implementation of Wireless FFA?
- What is the implementation process of Wireless FFA?
- What accounts for variances in field worker adoption of Wireless FFA?
- What is the impact of wireless FFA on business processes?
- What are the challenges of Wireless FFA?

2.1. What are the precursors for implementation of Wireless FFA?

Maxwell & Ren (2007) consider that there are three reasons that may push an organization to adopt FFA: compliance, service and value-cost. Compliance is factor

that pushes an organization to conform to legislative norms in a given sector. Service refers to the desire to improve the quality of customer service by accessing customer information, history and experience. Value-cost refers to the optimization of driving travel-time, telephone communication expenses and other consumables related to the cost of doing business.

According to Trentham & Scholl (2008), three factors may trigger a Wireless FFA project in a governmental context. These factors are curiosity regarding the potential of FFA, economic pressures to reduce the cost of field operations and improve the productivity of field force, and better management assets in the field as well as insufficient and/or inadequate managerial practices in response to accidents and disasters.

In the field service, Pousttchi & Thurnher (2006) , using Wang & Cheung (2004)'s organizational adoption[14] model applied to field service companies, demonstrate that precursor factors such as competitive pressure, availability of financial resources and computing resources, may trigger an FFA project independently of the size of company, while institutional factors do not incite organizations to adopt mobile technology that the vary according to the organization size (small, medium or large company). For example, *perception of the advantages* of wireless FFA and *risk-taking by the CIO* push small and medium enterprises to adopt mobile FFA. In contrast, *innovation orientation* is more important for larger companies.

However, *competitive pressure* and *availability of financial and computing resources* may influence the adoption of wireless FFA independent layoff company size.

A review of these precursor elements shows that economic/competitive pressures are the most important factors that motivate organizations to implement FFA, regardless of the organization being public or private, or the size of company, whereas other factors depend on the company sector or its size.

[14] Organization adoption is defined when the organization makes the decision to adopt the technology, while individual adoption is when users make individual decisions to adopt the technology (Leonard-Barton and Deschamps 1988)

2.2. What is the implementation process of mobile FFA projects?

A review of the literature discussing mobile FFA implementation processes indicates that some research covers all stages of the implementation process (Maxwell & Ren, 2007; Rangone, Renga, Catti, Mitrione, & Mondini, 2007) while others focus on a single phase of the process (Nah, Siau, & Sheng, 2005; Olofsson & Emborg, 2004; Scholl, Liu, Fidel, & Unsworth, 2007:de la Garza, 1998 #604; Zou, Ye, Peng, & Chen, 2006).

Table 8. Wireless FFA implementation process

Authors / concepts	Adoption drivers	Knowl-edge awareness	Definition of objectives and constraints	SWOT analysis	Option generation and selection	Evaluat-ion	Develop-ment and test	Roll-out	Adopt-ion	Bar-riers	Integ-ration
(Rangone et al. 2007)			•	•	•	•	•		•		
(Maxwell et al. 2007)	•	•			•	•	•		•	•	•
(Birkhofer et al. 2006)		•					•	•	•		
(Nah et al. 2005)			•								
(Scholl 2005)					•						
(Zou et al.. 2006)						•					
(Chen et al. 2008)					•						

A synthesis of the findings in the literature concerning mobile FFA implementation process reveals eleven stages:

- Adoption drivers[15]: at this stage the authors study factors that push organizations to invest in mobile FFA.
- Knowledge awareness: the organization becomes aware that mobile FFA exists and can resolve existing problems or increase organizational effectiveness by adopting.
- Definition of objectives and constraints: Nah et al. (2005) and Sheng et al. (2005) propose a framework called Value–Focused-Thinking to identify expected benefits from Wireless FFA.
- SWOT analysis: make an external analysis, by identifying Opportunities and Threats, and an internal analysis, by analyzing the Strengths and Weaknesses (Rangone et al., 2007).
- Option generation and selection: selection of an appropriate wireless solution for managing the field force.
- Evaluation: the majority of authors stress the economic dimension of adoption (Maxwell et al. 2007; de la Garza et al. 1998; Olofsson et al. 2004; Zou et al. 2006; Rangone et al. 2007), however, Rangone et al. (2007) integrate several other dimensions like strategic consistency, organizational impact and technological aspects.
- Development and testing: software has been tested both by the provider and by the customer (Birkhofer, Deibert, & Rothlauf, 2006). For the customer, this pilot period is important for identifying and eliminating problems. Two major problems exist at this stage in the identification of problems. If software and hardware are tested at the same time, it is difficult, if not impossible to identify the source and/or location of a problem. Responsibility for guaranteeing compatibility among different software solutions can be challenging if providers do not help the client in making their product work compatibly with other products.
- Rollout: selection and training of key users who then help their inexperienced colleagues to adopt and use Wireless FFA (Birkhofer et al., 2006).

[15] For more detail about adoption drivers, please refer to the preceding section

- Adoption: the acceptance of mobile FFA by users[16].
- Barriers: according to Maxwell & Ren (2007) the adoption process may encounter three barriers: contextual barriers (resistance from end-users and unions), innovation barriers (technological problems) and barriers arising from the interaction between contextual barriers and innovation barriers. Generally the strongest barrier encountered is the contextual barrier where end-users resist change.
- Integration: assuring that the end-user is fully committed to the system (Maxwell & Ren, 2007) by accentuating the benefits of system, field support for repair or replacement of broken devices, establishing user groups or forums.

2.3. What accounts for variance in field force adoption of mobile FFA?

In the case study of a public utility company, Nah et al. (2005) find that personality traits, training, and ease of use are the most important factors for the acceptance of mobile technology by the field force. Using exploratory qualitative research on several categories of professionals including field force, Isaac et al. (2007) found that adoption of mobile technology depends on the benefits and risks perceived by the professionals, particularly in terms of control over their activities. Barnes et al. (2006) state that the experience may influence the acceptance or rejection of FFA, since the field force has little experience in using FFA.

Gebauer & Shaw (2004) conducted a case study on a company that is currently developing and introducing a WAP-enabled mobile application to enhance its procurement system. They found that poor technology characteristics inhibit system use.

Lofgren (2007) conducted a case study of a mobile computing pilot project at Construction Company. They found that the adoption of wireless FFA depends on the usefulness, usability and utility of the technology. Usefulness is a factor that is directly related to the adoption of technology, while usability and utility is mediated by usefulness.

[16] For more details of influencing factors, please refer to the following section.

McDonald & Siegall (1996) conducted a survey of 205 technicians in a telecommunication company that implements Computerized Access for Technicians. They found that Technology-Self-Efficacy (TSE) is important in the context of mobile applications and found that technicians having high TSE are more satisfied with their work and committed to the company than those having a low TSE.

Chang & Kannan (2003) also performed a survey on 204 governmental employees working in the field and found that the Technology Readiness of Innovation (TRI)[17] can help predict the ease of adoption of wireless FFA. In addition training, availability of necessary resources, usefulness and ease of use have an impact on the success or failure of the adoption of an FFA. Following up on their initial study three years later, Chang & Kannan (2006) asked the same employees to study the evolution of the TRI concept. This study reveals that TRI evolves over time for groups who have adopted wireless FFA, especially as discomfort and insecurity dimensions decrease over time.

Several studies have used the Technology Acceptance Model (TAM)[18], or have extended it to the wireless FFA environment. Ciganek & Ramamurthy (2003) propose a research model that integrates the TAM model with the psychological climate[19] concept and they suggest that psychological climate moderates the adoption and the use of B2B mobile application.

In a recent study, Wu et al. (2007) utilize the TAM model to explain why field force, workers in the medical context, adopts mobile technology in a medical context. Auto-efficacy and compatibility were identified as factors affecting the adoption of mobile technology in addition to its usefulness and. These are factors that are directly related to the adoption of a technology, while Auto-Efficacy influences usefulness and ease of use but does not directly impact adoption. Like Lin et al. (2007), Walderhaug et al. (2008) deployed the TAM model in the context of military medical context to explain the

[17] TRI is defined as "people's propensity to embrace and use new technologies for accomplishing goals in home life and at work"(Parasuraman 2000)

[18]Davis's (1989) TAM model suggests that ease of use and usefulness can both be used to predict the adoption of technology. Ease of use is defined as "*the degree to which a person believes that using a particular system would enhance her/his job performance*". Usefulness is defined as "*the degree to which a person believes that using a particular system would be free of effort*"

[19] Koys and DeCotiis's (1991) concept integrates eight dimensions: autonomy, cohesiveness, fairness, innovation, pressure, recognition, support and trust.

acceptance of mobile technology. They found that acceptance depends more on usefulness and perceived compatibility and less on ease of use.

The literature review of Wireless FFA adoption shows that several factors can explain the adoption of Wireless FFA. These factors are summarized in the table 9.

Table 9. Wireless FFA adoption

Concepts/ Authors	(Wu et al. (2007)	Chang et al. (2006)	Isaac et al. (2007)	Chang et al. (2003)	(Walder-haug et al. (2008)	Nah et al. (2005)	Ciganek et al. (2003)	McDonald et al. (1996)	Gebauer et al. (2004)	Barnes et al. (2006)
Ease of use	•			•		•	•			
Usefulness	•			•	•		•			
Compatibility	•				•					
Technology readiness		•		•						
Auto-Efficacy	•							•		
Risk perception			•							
Personality						•				
Age										
Training				•		•				
Technology characteristics									•	•
Pschycological climate								•		
Availability of necessary resources				•						
Experience										•

Reviewing the literature concerning the adoption of Wireless FFA shows that:

- TAM's variables have been widely confirmed in the wireless FFA environment.
- Qualitative studies dominate existing research. This trend may be explained by the fact that the authors want to explore this emerging technology.

- Interesting factors identified in the qualitative studies, such as: personality traits, psychological climate, technological characteristics, risk perception, etc, must be tested and confirmed quantitatively.
- Wu et al. (2007) find that ease of use doesn't predict the acceptance of wireless FFA in the military context, while other studies, in other work contexts show that ease of use is an important factor in predicting the acceptance of wireless FFA. Studying the variation of acceptance between field workers is also an important issue because the differences in context from one field worker to another.

2.4. What is the impact of wireless FFA on business processes?

The mobile business process must be examined globally before studying the impact of Wireless FFA on this process.

2.4.1. Understanding the mobile business process

Mobile Business Process (MBP) is defined as being "*one that consists of one or more activities being performed at an uncertain location and requiring the worker to be mobile*" (Alag, 2006). According to Gruhn & Kohler (2007), MBP is composed of three elements (see figure 13):

- *Enterprise*: an entity that requires the execution of mobile tasks.
- *Headquarters*: coordinators of the mobile tasks.
- *Mobile workers*: workers who accomplish the mobile tasks.

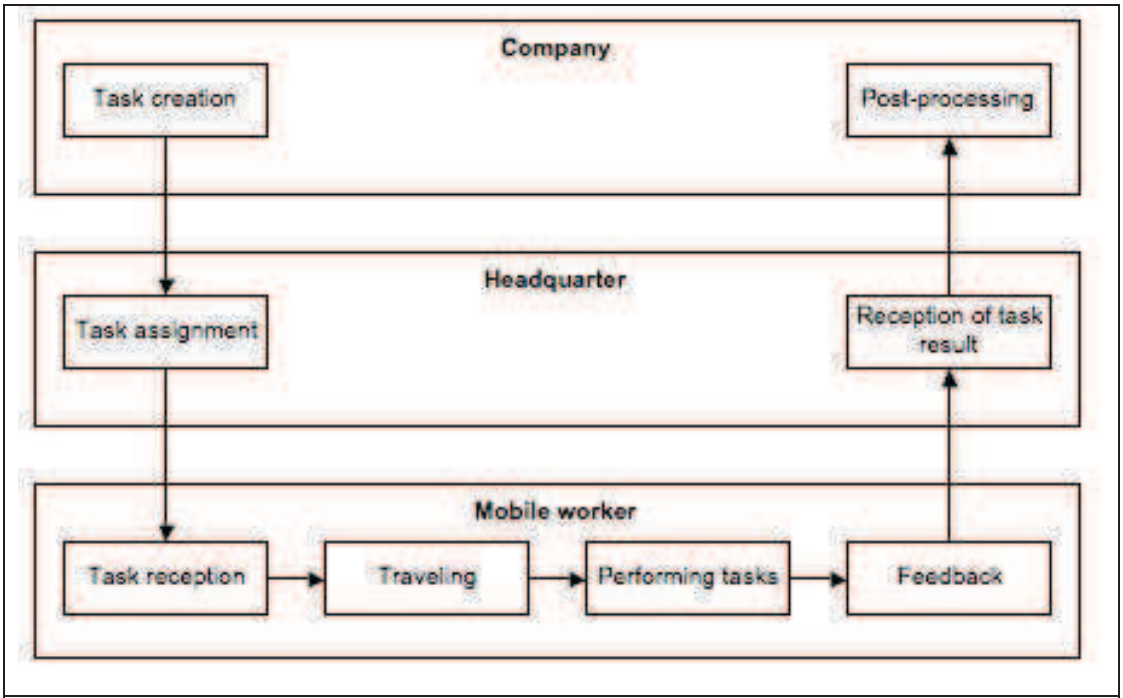


Figure 13. Mobile Business Process (Gruhn et al. 2007)

2.4.2. The impact of Wireless FFA on mobile business processes

In the field service context, Rossiet al. (2007) show that the use of Wireless FFA, especially SMS based applications, only supports the billing process. Before the implementation of this technology in a company, technicians sent bills to their clients by the post. After implementation, the bill is sent via SMS applications, thus reducing the time needed to complete the billing process.

In the maintenance context, Funk (2005) found that wireless FFA supports three activities: choosing the most appropriate technician, facilitating communication between the technician and the central station and globally, reduction of communication costs, increased labor productivity, and increased customer responsiveness.

In a telecommunication company using Wireless FFA, technicians do not need to report to the central station to pick up their work list because the dispatching process is technologically supported (Haugset, 2004). Pousttchi et al. (2006) found that the use of wireless FFA supports the transmission of service orders, execution of tasks at the customer site, and transmission of performance data. The use of this application leads to reduced redundancy, fewer errors, less wasted time, and fewer media breakdowns.

In the case of railway companies, Viehland & Yang (2007) show that Wireless FFA supports several activities related to inspector's work processes and saves time.

In a recent study of five field service operations, Thumher (2007) found that Wireless FFA supports all phases of the intervention management process, from dispatching to reporting. The use of this system leads to the reduction of time-to-bill, phone-calls, workload at the head office, and also increases first visit success rates.

The classification and the synthesis of this body of literature (see the following table) is based on two elements:

- Type of changes in processes: Wireless FFA may enhance or improve existing processes or integrally transform the existing processes (Pousttchi et al. 2006)
- Mobile Business process performance: according to Alag (2006), two reasons may drive organizations to mobilize the business process, the desire to improve the efficacy of the processes and the desire to increase employee productivity. Process efficacy means cost reduction and increased customer service. Increased productivity results from improved time and travel management**.**

Table 10. Impact of Wireless FFA on MBP

Authors	**Concerning processes**	**Type of changes in processes** (Pousttchi et al. 2006)		**MBP performance** (Alag 2006)	
		Enhance existing processes	Transform existing processes	Efficacy of processes	Personal productivity
Rossi et al. (2007)	Billing	•			•
Pousttchi et al. (2006)	Dispatching/ Managing intervention	•		•	•
Haugset (2004)	Dispatching/ Managing intervention	•			
Yang (2007)	Dispatching/ Managing intervention	•			•
Thurnher (2007)	Dispatching/ Managing intervention	•		•	•
Funk (2005)	Dispatching/ Managing intervention	•		•	•

The review of this body of literature shows that:

- All studies approached from the 'improved process" perspective indicate that wireless FFA supports small changes in existing processes.
- Wireless FFA used supporting dispatching and intervention management processes is widely studied, while other processes, like mobile procurement (parts procurement for example), billing, and control are as yet limited and need further research.
- Research on transformational view is absent. Location-Based-Application is a typical application of Wireless FFA that can transform existing processes. Research in this direction must be undertaken.

2.5. What are the challenges of Wireless FFA use?

Whitehurst (2006) argue that today the main driver for this sort of service organization to install mobile technology is their lack of communication with its mobile employees. That's why in short these companies are equipping their employees with high rate of these types of technology in order to communicate with them. In doing so, company culture becomes much more related to this complex technology for the accomplishment of the tasks by their employees. He adds that the use of these technologies make them more efficient but also creates multiple challenges. We can conclude, after reviewing the literature on wireless FFA, that technological, organizational and individual challenges arise when this technology is used in organizations.

2.5.1. Technological challenges

In spite of its recent technological advances, wireless FFA still has several technological problems. Scholl et al. (2007) and Saidi (2002) cite ergonomic factors. Haugset (2004), and Saidi et al. (2002) highlight the fact that the technology doesn't respond well to jobsite conditions such as humidity, temperature and rain. For Wiberg (2001) this technology supports only technical tasks but not complex tasks. And finally Scholl et al. (2007) remark upon the lack of synchronization, flexibility, reporting and information organization capacities.

2.5.2. Organizational challenges

Despite the fact that wireless FFA creates a more horizontal and more virtual organization, reduces the number of employees, and improves process efficiency (Borucki, Arat, & Kushchu, 2005), it also creates several organizational problems:

Control challenges: Lindgren et al. (2005) state that the implementation of wireless FFA in transportation organizations poses two control challenges. First, wireless FFA generates more data to process and implies more time devoted to controlling this data by sedentary workers and managers. Second, data generated by this technology doesn't integrate contextual factors to help making sound decisions.

Vas & Verle (2000), on the other hand, shows how the control implied by this technology can lead to forms of resistance from the technicians: explicit and implicit. Tacit resistance is not formally expressed and takes the form of inertia and covert acceptance. However, explicit resistance is clear formulated in strong words and tangible acts, and possibly rebellion and sabotage. In addition they find that these types of resistance differ according to the category of the actors concerned. For example, at the top management level, the resistance is tacit and it is manifested by a disguised acceptance, silence, lack of support and providing limited resources. At the middle management level: the resistance is both tacit and explicit and it is manifested by a disguised acceptance, double-talk, inertia, sabotage, false reports etc. Finally, at the operational level, resistance is explicit and it is manifested by claims, reduced production, absenteeism, arguments, threats, sabotage, amongst others.

Isaac (2006) carried out a qualitative study at the level of company mobile professional workers such as technicians. He found that even if this technology gives to its users more professionalism in doing their work, the feeling of permanent control and decreased autonomy inhibits the use of this new technology.

Alteration of Power: transparency of the information between "mobile" and "sedentary" provided by wireless FFA can alter the power balance since field workers can remotely access corporate information (Lindgren et al. 2005).

Communication challenges: Yang (2007), and Borucki et al. (2005) state that FFA implies less direct communication between employees. Liu et al. (2007) provide a detailed analysis of these communication challenges, which include *communication direction* (FFA systems that are not based on information coming from the field force),

communication channels (FFA systems supporting only explicit information and not supporting tacit information) and *communication climate* (relations between managers and field workers). When using Transport Data Management, Lindgren et al. (2005) find that several communication challenges arise between dispatchers and drivers. These include confidentiality issues, mistrust of technology (doubt of messages being sent and received correctly) and difficulty in making sense of the information provided.

Structural transformation: Vas & Verle (2000) finds that use of these FFA technologies changes the role of some employees in the back office (managing technicians in charge of work distribution) who become "coaches" instead of dispatchers. In the same vein, Ferneley & Light (2006) have studied how the implementation of FFA at the level of the Fire Brigade has altered the relationship between the primary users and the secondary users. In fact, the primary users are defined as those for which the technology is designed. They are those who actually use the newly implemented technology, and they have to interact with it directly by entering, manipulating and consulting the data. On the other hand, the secondary users are those who are not concerned initially by the design of this technology but are its recipients. The main difference between these two types of user is that the former interact directly with the technology in place, while the others do not. These changes take place in three dimensions: permanent contact, transfer of the decision process to technology and supervision. Concerning the first challenge, permanent contact, the operational employees, firemen (the second users), find that during their work their leaders (primary users) are more concerned with interacting with the technology than doing the work with their subordinates. As a result, this inattention increases uncertainty regarding the actions undertaken by the firemen. Concerning the second challenge, the authors find that the primary users now delegate all decisions to technology instead of using their judgment. Finally, the use of this technology alters supervision because it allows the primary users in the back office to control and take decisions in place of the drivers about which route to take or which action to undertake because they have become the deciding authority.

2.5.3. Challenges to the community

Wiberg (2001) was the first researcher to highlight the impact of this new technology on the technician community, after observing them at work. In fact, he finds that it affects teamwork because the technicians don't have to go to the central station to get their

workload as they can access to this workload from home. This deprives them of the opportunity of meeting up with their colleagues. However the technicians were conscious of the importance of the community aspect of their work. That's why, after a while, Wiberg finds that, after a while, technicians return to the traditional mode of working in order to maintain teamwork and shared practices.

A similar study has also been undertaken by Haugset (2004) for maintenance technicians for whom he also observed the impact of this new technology on their working community. He had the same findings as Wiberg. In fact he found that initially the technicians went to the central station in order to get their workload on paper, but that after the introduction of mobile technology they could download it at home and no longer came to the central station.

However, contrary to Wiberg, the management in this case was conscious of the profound change that mobile technology had had on the technician community. So, they decided to install "intranet", a virtual space used from home, in which all the technicians could get together, exchange information, ask questions and discuss the problems encountered in their day's work. Apparently the technicians ere not satisfied with this solution, as it was not sufficient to maintain the community, not being able to replace meeting face-to-face. That's why the technicians decided informally to maintain their communities of practice by getting together in the morning, before the official work-time.

It appears then, from this review, that little research has been done in this area and that the research done is just informative and explorative, considering the implications of the use of these new types of technology for organizations. It appears also that there is a new kind of resistance to managerial decisions because the technicians don't question the work itself, but do resist its new modalities. However, this review opens the path to a multitude of questions as yet unanswered in the existing literature: Why exactly do technicians try maintain communities of practice? How do communities of practice work in this new context, with new technologies compared to former ones? What is the nature of these communities that are taking shape? All these questions highlight change in organization and communities of practice. That's why are mainly related to the organizational change that will be studied in the next chapter.

2.5.4. Individual challenges

At the individual level, Wireless FFA generates several problems for field workers:

- Privacy concerns due to geo-localization technology (Borucki et al. 2005).
- Emergent competences (Borucki et al. 2005; Wiberg 2001).
- Transfer of tasks and responsibilities since mobile workers increasingly perform tasks previously linked to sedentary workers (Lindgren et al. (2005); Borucki et al. (2005).

3. Conclusion of chapter 1

In general, the objective of this chapter is to understand the new technology under study as well as its organizational implication and these two aspects are studied separately in the two sections of this chapter.

In the first section, I provide a global overview of Wireless FFA technology by defining its: target, functionalities, ecosystem and benefits. The main result of this review is to show that this technology addresses very many field workers like: firemen, truck drivers, technicians, etc. However, we still don't know for which population the impact of this technology is more important.

The second section of the chapter deals with this. I reviewed the different organizational challenges involved by the implementation of the FFA technology. The result of this review shows that this technology has had a great impact on organization at different levels: organizational, technological, individual and the community. However, it also revealed that the greatest impact of this technology is at the community level, at which only the technicians are concerned with this change.

What also emerges from the review is that few studies have been undertaken on the impact of these new technologies on technician communities, and that those are of explorative and informative interest but demonstrate neither the organizational impact of mobile technology on the actual work of the technicians, nor why this type of change is so fundamental for the work of the technicians?

Replying to these questions means now paying great attention to organizational change in order to understand its nature and the implications. The aim of the next chapter is to review existing theories on changes in organization or means of coordination.

CHAPTER 2 HOW TECHNOLOGY IMPACTS COORDINATION?

The aim of this chapter is to begin discussing the relationship between technology and coordination in organizational theories. More precisely, this connection will be examined with reference to the two dominants views of organization theory: technological imperative and organizational imperative. These views will be analyzed separately in two sections. Consequently, in the conclusion, I provide a cross-analysis of all these theories. In doing so, my aim is to clarify the limits of these theories and justify why a new approach of coordination change is required.

1. Section 1 The technological imperative view

The aim of this section is analyze the first perspective on the organizational change known as the technological imperative which includes two main theories: classical and the systemic views.

1.1. Classical view

Three major organizational theories have been developed according to the classical view: administrative, scientific and bureaucratic management. In what follows, each theory will be analyzed solely in connection with our problematic: the connection between coordination and technology.

1.1.1. Administrative management

The notion of coordination emerged in France through the work of Henri Fayol, working on administrative organization, and spread later to the Anglo-Saxon world with Mooney and Gulick who argue that coordination is the "*first principle of the organization*" and "*contains all the principles of organization, it likewise expresses all the purposes of organization, in so far as these purposes relate to its internal structure*". The following explains their agreement on the definition of coordination:

- "*The harmonization between all the acts of the company so as to ensure its functioning and its success*" (p. 147) (Fayol, 1917).

- "*The orderly arrangement of group effort, to provide unity of action in the pursuit of a common purpose*". (Mooney, 1947).

Four bases of homogenization are added by Gulick (1937): common purpose, common processes, clientele and geographical area. Organization is based on just one of these. According to these criteria, it appears that technology could be considered as a means of homogenization because it allows the harmonization of the work processes (second criterion):

"*If all the departments are set up on the basis of process, the work methods will be well standardized on professional lines, and the chief executive will have to see that these are coordinated in timed to produce the results and render the services for which the government exists, and that the service rendered actually fits the need of the persons or the area served*"

According to Gulick (1937), choosing the procedure of homogenization is not enough and a mutual interest for which people communicate informally should be developed.

Signs for the appreciation of coordination (Gulick, 1937)		**Example of** (Fayol, 1917)	
		Coordination	*Incoordination*
Doctrine	*Objective*	1- Each service work in agreement with others	1- Each service ignores or wants to ignore the others
	Procedure	2- In each department, divisions and subdivisions are exactly informed about the part they have to take in the common work and mutual support they must provide	2- There is a watertight division between the offices and the services
Mutual interest		3- The program of work of the diverse services and the subdivisions are continually informed	3- Nobody thinks about the general interest. Initiative and commitment are absent

Table 11. Signs of coordination and incoordination (Source: Personal)

However, as it is shown in the table above, some situations of incoordination may appear, whether at the level of the use of the procedure (or the technology) or from mutual interest. That's why a discipline (Gulick, 1937) or a command (Fayol, 1917) must be incorporated into managerial responsibility, in order to ensure coordination and for which there are seven requirements (Fayol, 1917):

1- Deep knowledge of the staff
2- Ability to eliminate incompetent members
3- Complete knowledge of all the conventions that link the company to its agents
4- Manager's own good example
5- Periodic inspections of the social structure by inspection of the synoptic tables
6- Meetings with senior staff in conferences to prepare the unity of direction and to focus efforts
7- Ability to ignore details of the employees' work
8- Encouragement of team spirit, initiative and commitment in the staff

1.1.2. Scientific Management

The previous conception of coordination was developed with a fundamental distinction between coordination and incoordination that is easily observed by managers and allows them to undertake corrective actions and maintain efficient organization. However, Taylor (1911) interestingly justifies how incoordination is observable for managers who are not concerned with the details of their employees' work and also how direct supervision is inefficient in facing this kind of problem. This invalidates principle 7 of the list of developed by (Fayol, 1917).

In fact, Taylor (1911) finds that when managers don't pay attention to the details of the activities and only keep focus only on the principal problems, the production machines are misused and a considerable amount of production time is lost. More precisely, he finds that this misuse is explained by a phenomenon called "laziness" that can be either natural or systematic. In the first case, lazy people slow down the production chain by imposing their proper rhythm on all the other employees, even the hardworking ones who wish to work faster.

Systematic "lazing around", on the other hand, is considered more problematic in the eye of Taylor and leads him to develop his theory of Scientific Management. In this

case the employees become aware of the limits of the system in which they work and decide to take advantage of it. In fact, Taylor observes that the system of remuneration based on working days pushes the employees to slow down the pace of work on purpose by voluntarily restricting the production of the machines they are working on. As such, this is not very problematic but becomes so when this mode of working is applied systematically, not only by all the employees in the factory but also to newcomers that are also informed systematically and comply with this internal "fundamental" principle.
What strikes Taylor is when the management is aware of this general problem but remains inactive. That's why he develops a new theory called scientific management in which the managers have to know all the details of the work so as to standardize it by selecting one method applied to all, known as "the one best way":
"*There are many different ways to do the same thing, 40, 50 or 100 maybe, in the same factory, and that is why there is a wide variety of tools to do the same job. Among the methods and tools used in each operation, there is always a method and a tool faster and better than others. They can be discovered only after a scientific analysis of all the methods and tools used by the workshop, an analysis based on accurate study of time and movements. Thus science may gradually replace empiricism in the mechanical arts*" (p.33)
In doing so, the workers are no longer free to use their own methods for the production machines but have to comply to specific rules and a "law of science" developed by their scientific managers who see their role evolve and become more concerned with "*developing this science, instructing the employees and assuming a large part of the responsibility of the results*". (p. 33)

1.1.3. Bureaucratic management

In line with scientific management, Weber (1947) confirms the importance of rules and technical knowledge for organizational efficiency:
"*The primary source of the superiority of bureaucratic administration lies in the role of technical knowledge which, through the development of modern technology and business methods in the production of goods, has become completely indispensable. In this respect, it makes no difference whether the economic system is organized on a capitalistic or socialistic basis. Indeed, if in the latter case a comparable level of*

technical efficiency were to be achieved, it would mean a tremendous increase in the importance of specialized bureaucracy" (p. 310).

However, what strikes Weber is that even if the employees accumulate all this technical knowledge to use the machines and then decide to get out of the organization and set up their own business, they do not at all impede organizational continuity. This phenomenon is known as "*bureaucratic machinery*" and must be explained by something more than a simple development of technical knowledge:

"*The question is always who controls the existing bureaucratic machinery. And such control is possible only in a very limited degree to persons who are not technical specialists. Generally speaking, the trained permanent official is more likely to get his way in the long run than his nominal superior, the Cabinet minister, who is not a specialist*" (p. 310).

In this way additional knowledge, in relation to technical knowledge, must be developed by non-technical specialists through their work experience in the service and kept by them as the secrets of their business:

"*For they acquire through the conduct of office a special knowledge of facts and have available a store of documentary material peculiar to themselves. While not peculiar to bureaucratic organizations, the concept of "official secrets" is certainly typical to them. It stands in relation to technical knowledge in somewhat the same position as commercial secrets do to technological training. It's a product of the striving for power*" (p. 311).

In summary, bureaucratic management includes both dimensions: technical knowledge and knowledge derived from experience allowing for the protection of private interests:

"*Bureaucracy is superior in knowledge, including both technical and knowledge of the concrete fact within its own sphere of interest, which is usually confined to the interests of a private business – capitalistic enterprise*" (p. 311).

1.1.4. Conclusion

Following the analysis, these theories highlight two means of coordination to ensure a better use of technology: direct supervision and standardization. However, and according to Woodward (1980), these means of coordination are not suitable when technology becomes more complex as in the case of continuous production. In order to

justify his position, he developed three technological categories, used in production manufacturing, and their suitable coordination means (see table 14).

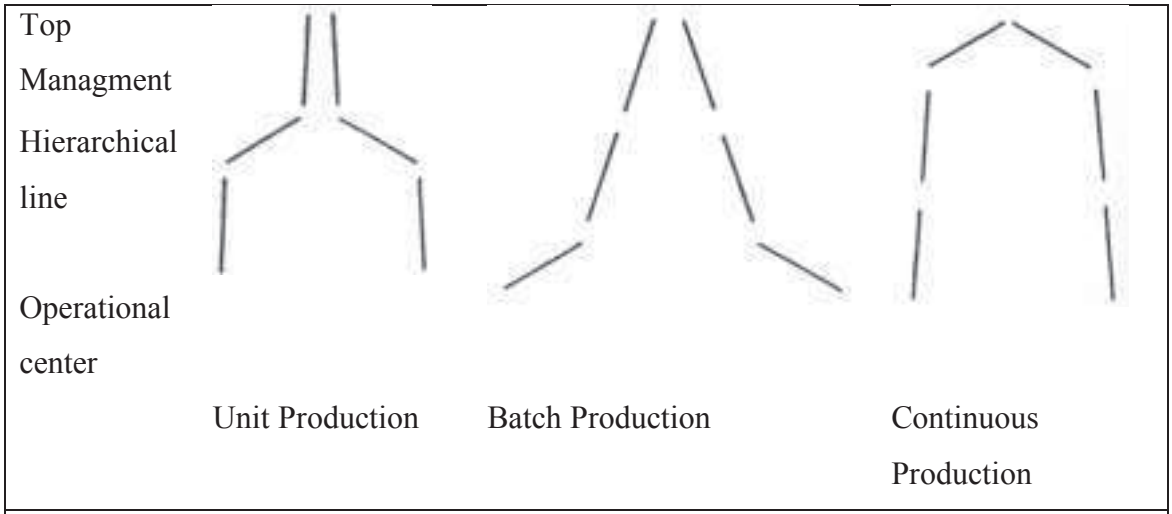


Figure 14. Types of production systems

The first type of technology is called Unit Production and is concerned with the production of non-standard products that can be neither formalized nor standardized. That's why this mode of production requires an organic structure in which the actors at the operational level must coordinate their work by first using the mutual adjustment mechanism. In addition to this mechanism, direct supervision is needed to control production because the managers work more closely to their subordinates. However, their control is limited because the type of work, in itself, requires a high level of competence. Moreover, the control by top management, in this type of production, is very limited.

The second type of production technology is called Batch Production. This type of production, contrary to unit production concerned with non-standard products, concerns standard products. In this case, the work is routinized, non-qualified and highly formalized. That's why little worker control is required but the area of supervision at top management level becomes larger and more involved. Moreover, when this type of system is introduced, many different sorts of conflict occur: between social and technical aspects, between the long-term vision of the top management and medium-term vision of the intermediate managers, and finally between the authority of the top-management and that of those having the functional expertise.

Unlike the two first modes of production, the last type, called Continuous Production, works on its own with all the standards and rules integrated within the system. In this way the system needs no control at all and the hierarchical line, previously in control, becomes employees in charge of logistical assistance, needing to control only themselves. At the operational level, this system replaces non-qualified workers by more qualified ones in charge of the maintenance of the system. The number of workers is also affected because this system requires only a small number of employees working in small groups and communicating via informal means of coordination.

1.2. Mintzberg's conception of technology and means of coordination

Before starting the analysis of the theory developed by Mintzberg that connects the technical system with the coordination means, I'll first present the general model that links complexity to coordination means inspired from the Woodward (1980)'s works, and from which he build his theory on the basis of these two dimensions

Mintzberg (1984) defines organization through two components: division of work and coordination. The first means dividing the organization into distinct tasks and the second one establishes the connection between these tasks. Mintzberg did not provide any explicit definition of the word coordination because he finds that it "*is a most complicated thing and calls for different means. We can call these means coordination mechanisms*" (p. 19). In this way, Mintzberg shift our attention from coordination to coordination mechanisms and identifies three coordination mechanisms (see figure 15).

The first mechanism is mutual adjustment in which the task of coordination is transferred to the operators themselves, who have entire control of their work. This mechanism is used in a simple situation as well as in a complex one, when a situation become difficult to anticipate and people have to adapt themselves to each other and improvise in order to cope.

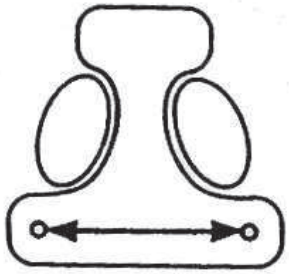
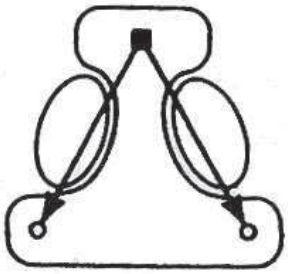
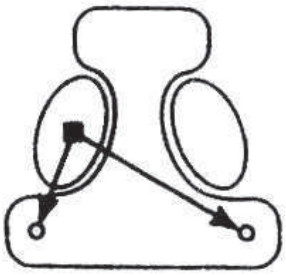
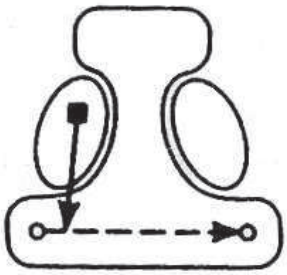
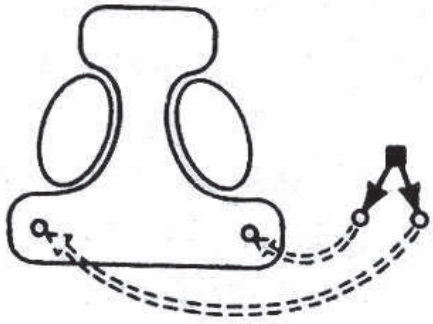
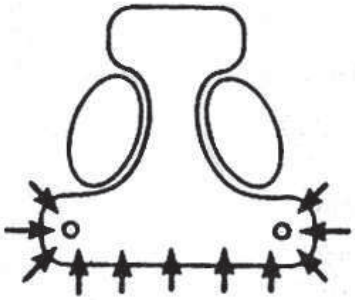
The second mechanism is called direct supervision in which one person is introduced within a group to exercise direct control over their work. Mintzberg compares this control to the one that our mind exercises over our hands.

The third means of coordination is called standardization in which coordination is accomplished even before the work is started. In this way, people do not worry about,

and are not concerned with coordination because they already know exactly what to expect from one another in the work and accordingly know what to do. Moreover, standardization is implemented in three different ways:

- *The standardization of work process*es: when the content of work is specified in advance and must be applied in order to get the work done, for example using instructions in order to assemble separate parts of the product.
- *The standardization of work outputs*: when the work outputs are specified in advance, like the dimensions of the product or the performance to achieve, without providing to the operator with any instruction or specific method to follow. In this way, the operator is free to use any method that allows him to achieve the required result.
- *Standardization of the worker skills*: in this case coordination is achieved by training all the people before entering the organization. In this training, all the work and coordination bases are introduced to newcomer so he can later use them spontaneously. This means of coordination allows the organization to achieve the first two types of standardization at the same time: standardization of the outputs and standardization of the work process.

Figure 15. Mintzberg's coordination means

		
Mutual adjustment	Direct supervision	The standardization of work processes
		
The standardization of work outputs	Standardization of qualifications	The standardization of norms

Mintzberg adds that the use of these means evolves according to the complexity of the task (see the next figure). These means are not required at all when a task involves just one person. However, coordination starts when someone else is involved in doing the task. In this case, coordination is achieved through mutual adjustment which is also adapted to tasks involving small groups working closely and where members adjust themselves through informal communication. However, this adjustment is no longer possible when many people are involved because an agreement is hard to. Then direct supervision is the appropriate means of coordination because control is required in this case in order to avoided t disagreement. However, direct supervision is, in turn, not appropriate an means when the number of workers become very high and impossible to control by just using a single mind. In this case, the work standardization of work and is suitable for simple and routine tasks. When the work becomes more complex, standardization by result is appropriate and it's up to the operator to choose the appropriate method to achieve the required result. When the degree of the complexity of the task also increases, standardization of the qualification is now required. Finally, returning to mutual adjustment is necessary when tasks can no longer be standardized and when adaptability is needed.

In general, an organization prefers to use standardization as their means of coordination but partially uses the two other means involving contact between people: direct supervision and mutual adjustment.

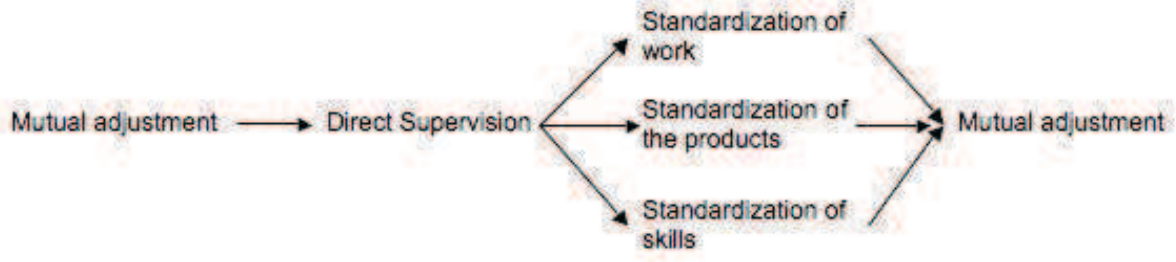


Figure 16. Coordination Mechanisms: a Continuum. Approximate Complexity (Mintzberg, 1984)

2. Section 2 Organizational Imperatives View

Contrary to the previous section, this one is concerned with organization as a trigger for change. In fact, this perspective argues that organization is an open system that faces numerous contingencies and must adapt by using an appropriate structure or means of coordination. This perspective is mainly developed in the information processing. Thus section is dedicated to presenting, first, the fundamental hypothesis of this theory and second, to reviewing all the papers developed in this perspective.

2.1. General presentation of the Information processing theory

2.1.1. What's information processing?

The fundamental issue is given in the name of this theory, "Information processing". (Argote, 1982) further explains that: "*the majority of the definitions commonly describe one characteristic of uncertainty, namely, incomplete information. Incomplete information makes it difficult to predict the future states of many factors associated with an organization's environment or tasks. Accordingly, it is difficult to plan or to fully specify organizational activities in advance*"

This is a recent offshoot of the contingency theory, which is still ambiguous is some ways. For instance, Galbraith (1973) asserts that the best organizational method is contingent to the diversity of the basic task performed by the organizational unit; what needs explanation is why uncertainty should have such an effect and how it can then be related to the design policy variables. On the other hand, Tushman & Nadler (1978) insists on the lack of clarity or the adequate match between information processing requirements and information processing capacity.

The "Information processing theory" must first be examined after defining two concepts: information and processing. Tushman & Nadler (1978) explains "*information refers to data which are relevant, accurate, timely and concise. As information must effectuate a change in knowledge, data may or may not be information, and data processing may or may not be information processing*". Thus, information should not be confused with data. In fact, information is data but, with the difference from simple data, it has an effect on knowledge. Processing refers to what happens "*during the actual execution of the task*" (Galbraith, 1973). He calls it processing rather than a process, to show that the interest focuses on the actual task rather than the previous task

or *per se*. "*It was suggested earlier that in predictable situations most of the coordination could be planned in advance of the task execution. It is not implied that there is no information processing in this preplanning. There is usually a great deal, depending on the division of labor, diversity of the outputs, and level of the performance*". Finally, information processing refers to "*the gathering, interpreting and synthesis of the information in the context of organizational decision making*" (Tushman & Nadler, 1978).

By defining information processing, I approach two central questions elicited by this theory and, in this way, I can explain why "theory" is added to "information processing":

1. Why is information processing required?
2. How is this informational need satisfied or, through which organizational mechanisms can this need be satisfied?

The second question does not cause any problems to define the different organizational and coordinative means used to satisfy the informational needs. In fact, all the authors agree on the existence of two organizational and coordinative means, known as mechanistic and organic. However, it is on the first question, concerning the increase of informational requirements that disagreement occurs. Indeed, some point out that information processing is required to cope with uncertainty while others stress that information processing increases due to two factors, uncertainty and equivocality. This divergence gives rise to two separate theoretical models of information processing, which will not be analyzed in this thesis.

2.1.2. Toward the Information processing theory

The initial theory in this case is developed on the basis of the dimensions of the uncertainty. This perspective will be developed in two stages. First, the model of this theory developed by Tushman & Nadler (1978) will be presented. This model will next be used as a point of reference for the following studies developed in this perspective.

Before providing in-depth analysis of this theory and reviewing existing literature, I propose a global view, using the model developed by Tushman & Nadler (1978) (see Figure 17).

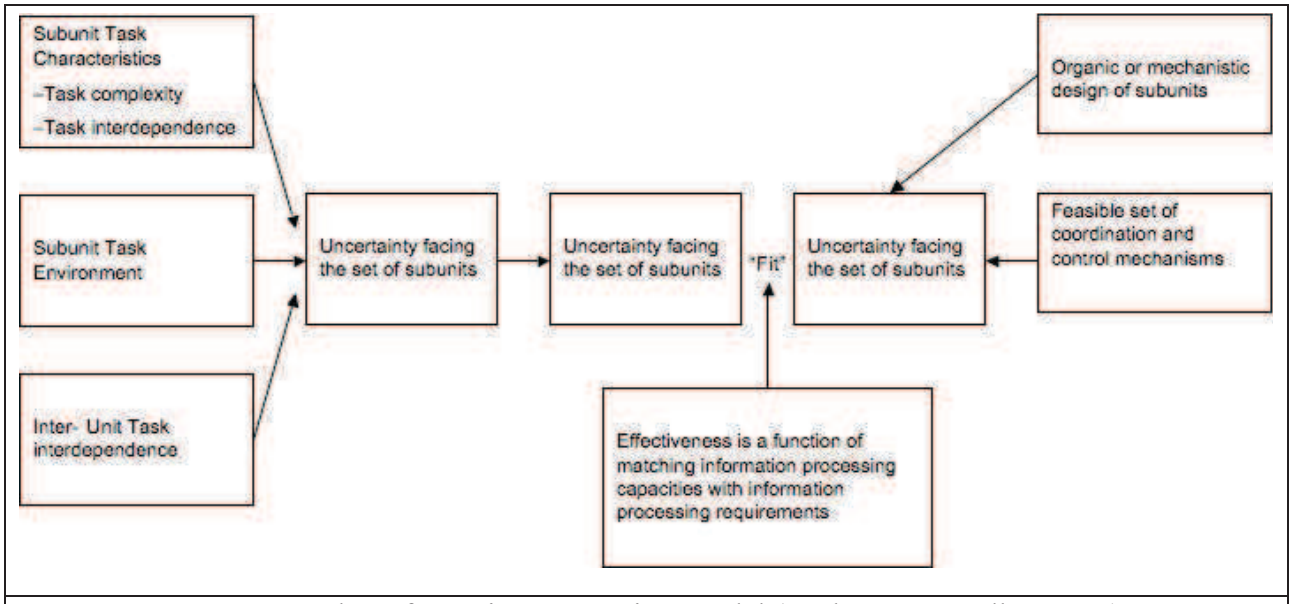


Figure 17. The Information Processing Model (Tushman & Nadler, 1978)

This model can be analyzed in two main parts, each dealing with one of the questions formulated above. The left half of the model is developed in answer to the question of why information processing is required. The response is uncertainty. It refers to the absence or incompleteness of information, defined as "*the inability to predict future outcomes or states of the world*" (Galbraith, 1977). This definition is widely accepted among the authors dealing with this concept (Daft & Lengel, 1986). What is more, uncertainty has three main sources: subunit task characteristics, subunit task environment and inter-unit task interdependence that will be discussed in detail below.

The right half of the model, on the other hand, deals with the second question and more precisely with how to cope with an increase in the need for information processing. The mechanisms differ according to the level of analysis of the source of uncertainty. If this is related to a single subunit level, the mechanisms used are of either organic or mechanistic structure. More precisely, the former is more suited to cope with a greater amount of uncertainty than the latter.

However, and if the second level of analysis concerns multiple subunits rather than a single one, the focus is more on the structure that could link or coordinate the different interdependent subunits. The structures used for this coordination include a range of different elements, including rules and procedures, planning and control systems, and specific coordinating units such as product teams or task forces. Furthermore, the use of these mechanisms differs according to the degree of uncertainty for which more

complex mechanisms are generally suitable. With reference to these two levels of analysis, this thesis deals with connection and coordination within a subunit rather than the relationship between subunits. However, the review of the literature below will not be restricted to this level of analysis, choosing to develop both within and between subunits. The objective is to avoid confusion that could arise from the use of similar concepts at two levels, for instance the concept of interdependence, which is used at both levels of analysis.

2.2. Literature review

As I stressed above, Tushman's model will be used as a point of reference in order to review existing literature. More precisely, I use its three major sources of uncertainty (subunit task characteristics, subunit task environment, inter-unit task interdependence) in order to classify and regroup the different contingent factors developed in the literature and derived from wider sources. Moreover, within the scope of this hypothesis, the review will not be restricted to analysis of the contingent factors but also to their corresponding mechanisms.

2.2.1. Subunit task characteristic

It is in this dimension that variation is more widely discussed across the organization theory. At this level and throughout the literature review, six contingent factors arise, that could affect subsequent coordination: uncertainty, interdependence, unit size, functional diversity, input uncertainty and complexity. Each one will be analyzed, first in isolation, examining the structural capacity required to fit and to guarantee effectiveness. This type of analysis will be followed by a more general one, providing a wider discussion of the sources of analysis. I develop these analyses via the two organizational dimensions: the first one is more related to uncertainty and its links are obvious, whereas the second one concerns the contingent factors that could decrease or increase organization.

2.2.1.1. Task uncertainty

I first use two definitions to identify task uncertainty. After analysis, it appears that it is none other than technology, which is thus acknowledged as a major dimension.

(Galbraith, 1973, 1977) was the first to develop this dimension by defining it as "*the difference between the required information as defined above and the amount already*

possessed by the organization" (p. 38). This difference is then explained according to the level of understanding of their task, by the individuals accomplishing it. This understanding varies with the nature of the task itself and more precisely, according to three aspects of a given task: the "*diversity of goals"*, the "*division of labor"* and the "*level of goal performance*".

The first dimension, diversity of goals, explains that each task is related to a specific aspect of the environment and the diversity stems from the many different aspects of the environment.

The second dimension is related to the division of labor which increases the amount of diversity. As initially designated, it first determines if, for my task, I need to process more information or not with reference to other units. This dimension is similar to what Mintzberg calls "*space*" and provides more detailed analysis of the contingency factor. This notion of space refers to two elements: the localization of the company and its geographical dispersion. The first one also includes also two further considerations: the background or setting in which the activity is accomplished (and then to the higher level of specialization) and the local culture (difference due to specific space-time shared by local cultures). Activity distribution (geographical dispersion) refers to the extent of the space in which the organization operates and for which other organizations are needed for cooperation.

The third dimension, level of goal performance, arises from a need for fresh information because when the performance level is high then many variables come into play simultaneously. This level of understanding determines the goal performance. After defining how task uncertainty increases information requirements, an organization design is required to accommodate these needs.

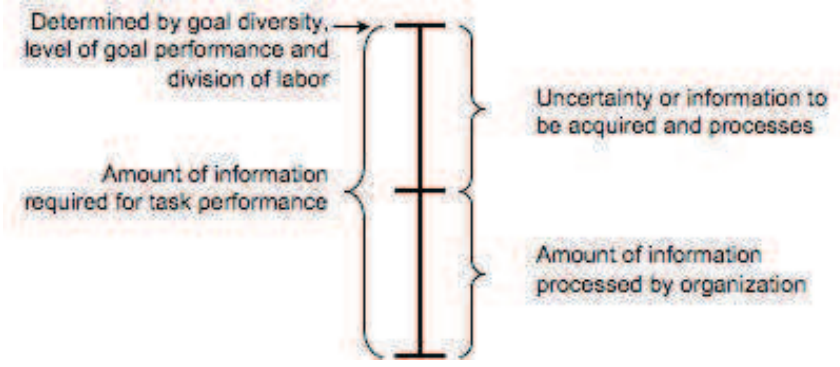


Figure 18. Determinants of information and task uncertainty (Galbraith, 1977)

2.2.1.2. Technology

This dimension refers to technology which is encompassed by task uncertainty, because if I refer to Van de Ven et al. (1976), task uncertainty is defined by to two aspects, initially developed by Perrow (1967), variability and analyzability; "*task uncertainty refers to the difficulty and variability of the work undertaken by an organizational unit*". By looking back to their original version, I find that they refer to technology, "*two aspects of technology vary independently: the number of exceptions that must be handled, and the degree to which search is an analyzable or unanalyzable procedure*" (p. 194).

However, before describing variability and analyzability, a definition of technology is required in order to understand the use and necessity of the former. In fact, Perrow (1967) defines technology as "*the actions that an individual performs upon an object, with or without the aid of tools or mechanical devices, in order to make some change in that object*" (p. 195). Defining technology in this way gives a perception of the contingent nature of this dimension because during the action of transforming an object (or raw materials) people can interact. However, this definition does not provide any precision about when or whether interaction is required or not during the transformation. It is to that end that Perrow develops the concepts of variability and analyzability. The first refers to "*the number of exceptional cases encountered in the work, that is, the degree to which stimuli are perceived as familiar or unfamiliar*" (p. 195-196). The second refers to "*the nature of the search process that is undertaken by the individual when exceptions. The first refers to the way that people has already*". Putting these two components together into the same framework provides a better understanding of how their combination operates.

Two modes of coordination arise from this analysis**:** routine and non-routine. Routine is when there is a rigid sequence of steps to resolve a problem. The way they are combined is a way of defining the degree of uncertainty. Logically, when the task is analyzable and non-variable, uncertainty is low. However, as soon as a variation occurs in one of the two (for example through the increase of exceptions or through an increase of the difficulty of the work), task uncertainty increases and impersonal modes of coordination are not adapted; the situation requires group or personal means of coordination.

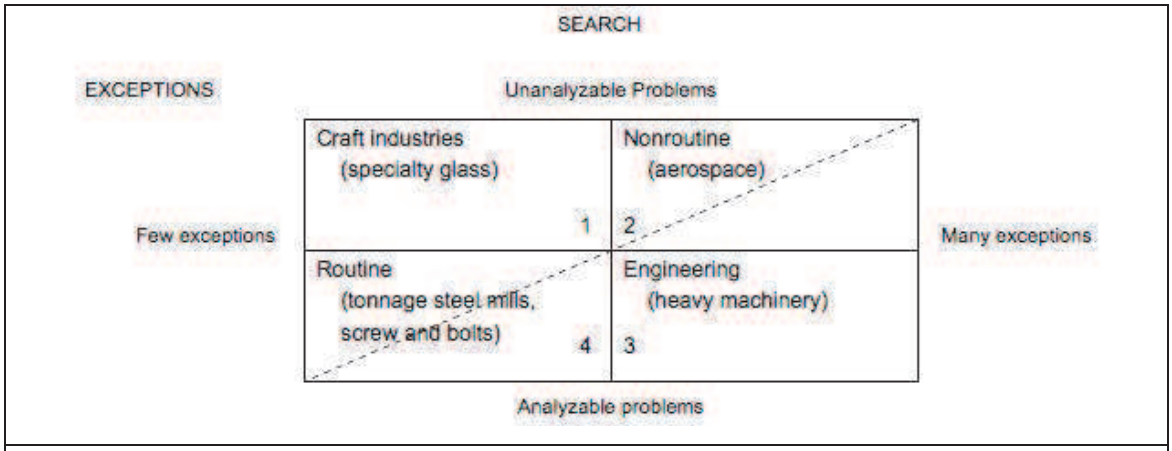


Figure 19. Technology Variable (Industrial example) (Perrow, 1967)

The application of this theory in the technological domain implies revision and extension of the model developed by Perrow (1967) since his theory does not fulfill its aim. In fact, Perrow's model, as it was initially developed, aims at paying *" systematic attention to the role of technology in analyzing and comparing organizations as whole, is believed to be distinctive*" (p. 195). This systemic view of organization as a whole rather than separate parts, is provided by a technology model that includes four distinct domains derived from the combination of the two technology dimensions: task analyzability and task variability (see Figure 19). However, the systemic view is not maintained but shifts towards a one-dimensional analysis that is more work-related and better fits the fundamental idea of the theory of information processing: "*A one-dimensional scheme would follow the dotted line from routine to non-routine*" (p. 196).

2.2.1.3. Task intra-interdependence

To develop this second source of uncertainty, I call upon what is known as "*Coordination theory*" developed essentially by Malone and Crowston (Malone & Crowston, 1990, 1994; Malone et al., 1999). This theory was developed, in the same vein as the Information-processing theory and as (Faraj & Xiao, 2006) concludes, "*it (coordination theory) shares with the information-processing view the assumption that the environment is predictable enough to characterize existing interdependencies and that predefined mechanisms can be designed for various contingencies*" (p. 1156). More precisely, this theory, like the theory of information-processing, tries to understand the match between information-processing requirements and coordination means, by

examining interdependence and coordination (see table 12), defined as the "*act of managing interdependencies*" (Malone & Crowston, 1990, 1994; Malone et al., 1999)). The application of this theory is made possible by the development of three types of interdependency: "*perquisite, shared resource and simultaneous"* (Malone & Crowston, 1990, 1994) (labeled later by Malone et al. (1999) as: "*flow dependency, sharing dependency, and fit dependency*". These types examined essentially the way common objects are used by interdependent activities. In fact, the central argument is that interdependent activities have certain objects (Malone & Crowston, 1990, 1994) or resources in common (Malone et al., 1999), although their use differs.

After defining how these types of interdependence come into being, it is easy now, to define each one. The first type of interdependence, perquisite, implies that an object could be use in a task only if created for another task. The second one, shared resource, concerns the use of the same object for different tasks. The last one, simultaneity, occurs when multiple tasks produce the same object. It is only via the latter that uncertainty increases and then synchronization is required in order to manage this interdependency. However, in the first two, uncertainty is low and then more preplanned means, like ordering activities or allocating resources, are needed.

Kinds of interdependence	**Common object**	**Examples of interdependence in manufacturing**	**Examples of coordination processes for managing interdependence**
Generic:			
Prerequisite	Output of one activity which is required by the next activity	Parts must be delivered in time for use	Ordering activities, moving information from one activity to the next
Shared resource	Resource required by multiple activities	Two parts installed with a common tool	Allocating resources
Simultaneity	Time at which more than one activity must occur	Installing two matched parts at the same time	Synchronizing activities
Domain-specific:			
Manufacturability	Part	Part designed by engineering must be made by manufacturing	Decision-making (e.g., negotiation, appeal
Customer relations	Customer	Both field service and sales personnel deal with same customer	Information sharing (e.g., sharing problem reports)

Table 12. Preliminary examples of kinds of interdependence (Malone & Crowston, 1990)

2.2.1.4. Unit size

This refers to the number of people within a single unit (Van de Ven et al., 1976). This number affects the level of uncertainty because when this number increases, uncertainty also increases and then more information is required. To deal with this need for

information, coordination is more related to impersonal means and less to the group and personal coordination means.

2.2.1.5. Input uncertainty

What is new in this case is that the task is brought into the realm of task-related uncertainty. In doing so it leaves the fundamental dimension of uncertainty in that it is related to incomplete information at the expense of the availability of multiple choices in this case.

In general, Argote (1982) develops a new source of uncertainty and, in some ways, an innovative dimension compared to the ones described previously. She develops a type of uncertainty that brings together both uncertainty dimensions that were historically developed separately: the external environment and task uncertainty are blended into a single type of uncertainty known as input uncertainty**,** involving the execution of the task within the unit:

"*The concept of input uncertainty bridges the somewhat artificial distinction between environmental and task-related uncertainty. Input uncertainty stems from the external environment with which the various units are in continuous contact, yet it has an immediate impact on the task that the units perform. Input is a specific type of uncertainty*" (p.422).

More precisely, this concept shifts attention from the uncertainty previously developed as incomplete information, on the grounds that the dimensions referred to "*the number of choices or alternatives in a given situation*". This new concept is developed in order to show how uncertainty increases when input uncertainty increases and how this increase requires structural or coordination mechanisms to deal with this high-level of uncertainty Two coordination means were developed with that aim the programmed means of coordination and non-programmed means. The first is used when the input uncertainty is low while the second is used when the input uncertainty is high.

2.2.1.6. Task complexity

March & Simon (1969) defines task complexity in which simple and complex situations are distinguished. Simple situations refer to "*a) the choice among which action to undertake, one of them is clearly identifiable; b) and the possibility of the preferred choice is good enough in order to be acceptable*" (p. 112). Moreover, those situations

are characterized by their rapidity and the absence of *a posteriori* evaluation of the chosen alternative. However, when the situation is complex "*if no choice is clearly better than others, or if the best possible choice is not good enough*" (p. 112). Those situations are characterized by delays in the situations and an *a posteriori* evaluation is always required. More precisely, there are three situations in which complexity arises:

1. Unacceptability: that the choice to be undertaken is not good enough.
2. Incompatibility: knowing the probable consequences, despite inability to identify a preferential choice
3. Uncertainty: the individual ignores the probable effects that link the conduct or the action to the consequences due to the environment.

However, this definition of complexity is restricted to objective task characteristics and less related to the "*several interrelated and conflicting elements to satisfy*" (Campbell, 1988). These elements are none other than contingent factors that can be combined with each other to define the complexity of the task (van Fenema, Pentland, & Kumar, 2004). In addition, this combination must always include an element of interdependence but not necessarily an element of uncertainty (van Fenema et al., 2004).

2.2.2. Inter-unit task characteristics

The two following factors are more related to conflictual situations. According to (March & Simon, 1969), there are two different types of conflict: individual and organizational. The main distinction between them is that the first type of conflict is between to individuals and related to difficulty in choosing one alternative among many. However, in the organizational conflict, individual conflict is absent because individuals have already identified different acceptable alternatives, but don't agree on the choice of which is best.

The previous factor is related to individual conflicts limited to individuals while functional diversity is more related to organizational conflict, (conflicts arising between individuals from different units). The initial condition for this conflict is a need for a joint decision (March & Simon, 1969). This need arises from two central organizational problems: resource allocation and planning. In fact, when different groups have a mutual dependence regarding a limited resource or when a need for synchronization of the activity is high, then the need for joint decision is equally high, and it is necessary to participate with other groups in a common decision. However, this common decision is

not easy to achieve because each individual comes up with a specific alternative and does not agree with those from other people, other units or other departments. This divergence, followed by conflict, can be attributed to certain differences concerning: cognitive orientation, language and shared coding schemes, individual perceptions, power, culture in occupational communities and perspectives in occupational communities, and are analyzed below.

2.2.2.1. Inter-unit task interdependence

As the title shows, the difference is between the two types of task interdependence developed above but is not sufficient to clarify the profound difference between the two aspects. One concerns relations within the unit while the other concerns what happens between units.

This level of interdependence should not be confused with the one developed previously by Malone and Crowston that simply concerns task interdependence. To avoid this confusion, a precise definition of the concept of interdependence is first required. The complexity of this concept, whether at the theoretical or the empirical level makes this difficult, ((Penning, 1974) cited by (Van de Ven et al., 1976)). However, the clarification of this concept is still possible, but only by defining the different levels of "interconnectedness".

Four levels have been identified: "*task (the flow of work between actors), role (the position of actors engaged in concerted action), social (mutual needs or goals of actors) and knowledge (the differentiated expertise of actors)*" ((Penning, 1974) cited by (Van de Ven et al., 1976)). Among these four types of interconnectedness, only the two first are related to our issue. More precisely, task interdependence, developed by Malone is more related to the first type of task interconnectedness, because interdependence is more a question of easy flow; this perspective is justified through the definition that they gave of coordination as "*the act of working together harmoniously*" (Malone & Crowston, 1990). The link to the task becomes more obvious in the last definition of coordination, as "*managing dependencies among activities*" (Malone & Crowston, 1994), through the word "*activities*". On the other hand, inter-unit task interdependence implies role interdependence as this perspective concerns concerted action, "*in situations of interdependence, concerted action comes about through coordination*" (Thompson, 1967).

After providing a clear distinction between these two types of interdependence, inter-unit task interdependence can be examined. This perspective has been furthest developed by Thompson (1967), focusing on three types of interdependence: pooled, sequential and reciprocal. The first type of interdependence represents the lowest level because tasks in this case share common resources; however, each task could be done in an independent way. In the second type of interdependence, members work one after the other. Finally, reciprocal interdependence is the case when members provide work for each other.

It is only via the latter that uncertainty increases, leading to information processing requirements, coordination, mutual adjustment and the transmission of fresh information. However in the two first cases, uncertainty is low and coordination is achieved by standardization ("*establishment of routines or rules which constrain action of each unit or position into paths consistent with those taken by others in the interdependent relationship*" (p. 56) or by planning ("*establishment of schedules for the interdependent units by which their actions may be then governed*" (p. 56)). This result was later empirically confirmed by Van de Ven et al. (1976) who found that when workflow interdependence increases then uncertainty increases and group mechanisms are required. However, when this workflow is small or moderate only impersonal or personal mechanisms of coordination are required.

2.2.2.2. Functional diversity

2.2.2.2.1. Cognitive orientation

Lawrence & Lorsch (1989) defines the different dimensions as "*the difference of cognitive and affective orientations of managers in different functional departments*" (p.28), making a distinction between the differentiation of orientation and differentiation of structure. In this way he adds a new dimension. The latter has been widely studied in the classical organizational theory by arguing that different structures require different means of integration. However, what these studies miss are the systemic properties of organization that arise during the act of departmentalization and then specialization. More precisely, they miss the different behaviors and attitudes in what occurs between organizational members of different departments or structures.

This is essentially due to the difference of orientation, which can be classified into two main categories: the difference between cognitive orientation and structural difference.

a) Difference of orientation specifics objectives: for example when members of the production department are more concerned with cost reduction while their colleagues in the marketing department are more concerned with the sales volume. (March & Simon, 1969) adds that this differentiation is due to two factors:
   - Subjective operationality of the objective: when this operationality is low, conflicts arise This decrease is due to three factors: (1) the type of work in organization (objective in the organization of research development rather than organization in the production sector), (2) the size of the company and finally (3) the hierarchical level (objectives are less operationalized at the higher level of organization than at the lower lever).
   - Limited resources: in fact when there is latitude regarding resources, conflicts do not arise because those resources can be allocated rationally among the departments. However when resources are limited, this latitude disappears and conflicts begin in order to distribute these resources.
b) The projection of their actions in time: some members in the departments are more concerned with short-erm actions while others are more concerned with long-term actions.
c) Interpersonal orientation: behavior toward colleagues according to their specialties.
d) Formal structure: when each department has its own specific structure and organization that are not necessarily shared by the other departments

According to Lawrence & Lorsch (1989), these four dimensions differentiate between organizational units. In fact when organizations or units share similar points of view regarding the four dimensions, differentiation is low. However, when members of the organization don't share the same point of view on one of the four above dimensions, differentiation is high. The latter situation appears commonly in normal organization; conflict resolution and integration differ according to the characteristics of the environment. In fact, when differentiation occurs in an environment of certainty, integration is achieved with hierarchical means. However, when differentiation occurs

in an uncertain environment, integration is achieved through organic means of coordination.

2.2.2.2.2. Language or shared coding schemes

Tushman (1978) refers to the interaction between departments as the task project. More precisely, they use the case of the R&D department because they are in constant interaction with the other departments. It appears that to accomplish a task, this type of department does not use formal structures, preferring informal means and oral communication. However, this is not always effective. In fact, more interaction and a greater amount of communication between departments do not solve the problem because there are differences in their "*shared coding scheme"*. In fact, these situations require another type of communication named "*extra-unit communication*," having different sources of effective technical feedback, evaluation and support.

2.2.2.2.3. Individual perception

Dearborn & Simon (1958) proposes the dimension of "*selective perception*" that can create conflict between departments because each executive, when dealing with stimuli or aspects of the situation, uses his own departmental goals, rather than aspects relevant to the stimulus of the situation:

"*Presented with a complex stimulus, the subject perceives; the more complex or ambiguous the stimuli, the more the perception is determined by what is already "in" the subject and less by what is in the stimulus*" (p. 140)

March & Simon (1969) adds that this difference of perception is not only due to departmentalization but also to the characteristics of the organization. In fact, and like Dearborn & Simon (1958), they argue that conflicts arise because individuals from heterogeneous groups hold different sources of information. In addition to the departmentalization factor, they argue that the characteristic of the organization and, more precisely the routing of information, affects the differentiation of perception; the longer the routing of information the greater the differentiation in individual perception. The routing of the information is defined as "*limiting the number of members of the organization to which any given item of information is transmitted*" (p. 126). This routing is influenced by informational structure used by the organization for communication. For example, when the members of different departments are situated

in a similar space, differentiation is reduced because of the frequent interactions and the sharing of information. However, when departments are located in different spaces and work in autonomous way the differentiation will be high.

2.2.2.2.4. Power

Riley (1983) tries to find the structure that best fits the situation and develops the structures that correspond to the organization symbols.

2.2.2.2.5. Culture in occupational communities

It is only through this dimension that occupational communities appear. Van Maanen & Barley (1984) refers to this dimension as self-control through which members of the occupational community exercise control over their work; this occurs even if they are submitted to multiple chains of control. This self-control in occupational communities makes their control difficult:

"*Self-control is problematic to members of an occupational community only when organizational officials seek to impose certain "outsider" standards, goals, work tasks, evaluative scheme and so forth upon the membership. In and of itself, hierarchy is not an issue. It is the use of hierarchical authority to direct member activities in ways the membership considers untoward that presents the problem and threat to self control*" (p. 36-37).

2.2.2.2.6. Perspective in the occupational communities

This perspective is related to the sharing of knowledge between the different departments. Due to the specialization of the department and the interaction with specific environment, the service develops specific knowledge in order to respond to this environment. In fact, they develop their own specific knowledge that makes interdepartmental exchange difficult. The literature shows that these difficulties arise from a global or local comprehension: a question of "*perspective*" (Boland & Tenkasi, 1995). This difference in perspective can be related to the difference in "*thought worlds*" (Dougherty, 1992) or in "*local work context*" (Bechky, 2003).

To further understand these differences of perspective, I evoke the difference in the global level of understanding between department and community because it stems from a more general misunderstanding (Dougherty, 1992) and in the difference between thought worlds "*each (department) emphasizes different aspects of development,*

however, and conceives the whole in different way" (p. 191). He adds that this takes place only at a deeper level than the conflicts related to the individual personality level. However, it is more related to the process of negotiation between the departments about the goals. Dougherty (1992) adds that this type of misunderstanding can only be grasped in intense situations (for example in the case of accidents or in troubled work relationships.

On the other hand, Bechky (2003) develops the difference of perspective at a lower local level, which is related to local/situational context of work, and more precisely, how this factor impedes the sharing of knowledge. He determines three dimensions: the difference in language, in the locus of their practices and finally in the conceptualization of the product.

In his study these differences are illustrated by examples of table key differences applied to the case (see table 13).

	Engineers	**Assemblers**	**Technicians**
Work	Produce Drawings	Build machine	Build prototypes and correct drawings
Locus of practice	Conceptual	Physical	Conceptual and physical
Conceptualization of product	Schematic: form, fit, and function	Spatio-temporal and processual: how and in what order the machine is built?	Manufacturability: Will the machine work?
Language	Engineering drawing language	Language of the machine	Engineering drawing language and language of the machine
Exemplar	"It's way more crowded than it looked on my screen!"	"This valve goes around the other side."	Assembler's "motor" reported to engineer as "harmonic cable".

Table 13. Key differences in the work context of the three occupational communities (Bechky, 2003)

Because this level of differentiation is deeper than the others developed, perspectives from different communities are required to get their respective versions (Dougherty, 1992). However, in getting these stories and analyzing the intense events, the normal events must not be forgotten. In fact the analysis of these stories must include both events: those arising within (perspective-making) and between (perspective-taking) communities (Boland & Tenkasi, 1995). The latter develops his argumentation based on the narrative structure of the story proposed by (Chatman, 1978). Chatman refers to these events as major or minor and argues that they coexist within the same narrative structure. He adds that the existence of major events first requires minor events, but that the opposite does not occur.

2.2.3. Subunit task environment

Finally, task environment refers to "*those external actors which are attended to by organizational members. The environment is generally seen as a source of uncertainty, since areas outside the organization (or subunit) are not under the unit's control and are therefore potentially unstable*" (p. 616). Two types of environment create different types of uncertainty: static and dynamic. The distinction between these characteristics is based on the aspect of stability or the frequency of change over time in the environment (Duncan, 1972), "*the static-dynamic dimension indicates the degree to which the factors of the decision unit's internal and external environment remain basically the same over time or are in continual process of change*" (p. 616).

Thus, uncertainty increases only when the environment is dynamic. In this case, more informal means of coordination are required. However, when the environment is stable, uncertainty is low, and in this case, fixed rules and standard operating procedures are more suitable.

All the reviewed factors of uncertainty will be summarized in the following table and will be organized according to (Tushman & Nadler, 1978)'s model described above.

Environment	Sources	Contingent factors	Definition	Dimension	Coordination mode
		Task uncertainty (Galbraith, 1973, 1977)	"The difference between the amount of information required to perform the task and the amount of information already possessed by the organization" (p. 36-37) (Galbraith, 1977)	1. Goal diversity 2. Goal performance 3. Division of labor • Localization • Distribution	• Preplanned • Unplanned (Galbraith, 1973, 1977)
		Task intra-interdependence (Malone & Crowston, 1990, 1994; Malone et al., 1999)	"The flow of work between actors" (p. 324) ((Penning, 1974) in (Van de Ven et al., 1976))	1. Perquisite 2. Sharing 3. Simultaneity	• Ordering or allocating • Synchronizing (Malone & Crowston, 1990, 1994; Malone et al., 1999)
		Unit size (Van de Ven et al., 1976)	"Size is defined here as the total number of people employed in a work unit" (p. 326) (Van de Ven et al., 1976).	NA	• Impersonal • Personal/group (Van de Ven et al., 1976)
		Input uncertainty	" The number of choices or alternatives in a given situation"	NA	• Programmed • Nonprogram-

		(Argote, 1982)	(p. 422) (Argote, 1982).		med (Argote, 1982)
		Task complexity (March & Simon, 1969)	"Several interrelated and conflicting elements to satisfy" (Campbell, 1988)	NA	NA
Internal	Inter-unit Task	Work flow interdependence (Thompson, 1967); (Van de Ven et al., 1976); (Galbraith, 1973; MacCann & Galbraith, 1981)	"The position of actors engaged in concerted action" (p. 324-325) ((Penning, 1974) in (Van de Ven et al., 1976)).	1. Pooled 2. Sequential 3. Reciprocal	• Standardization or planning • Mutual adjustment (Thompson, 1967)

	interdependence	Functional diversity (Lawrence & Lorsch, 1989)		1. Cognitive orientations (Lawrence & Lorsch, 1989) 2. Formal structure (Lawrence & Lorsch, 1989) 3. Languages (Tushman, 1978) 4. Perceptions (Dearborn & Simon, 1958); (March & Simon, 1969) 5. Culture of Occupational Communities (Van Maanen & Barley, 1984) 6. Thoughts worlds (Dougherty, 1992) 7. Power (Riley, 1983)	

External	Environ-ment	Task environment	"Task environment can be defined as those external actors which are attended to by organizational members. The environment is generally seen as a source of uncertainty, since areas outside the organization (or subunit) " (p. 616) (Tushman & Nadler, 1978).	1. Dynamic 2. Static	• Rules • Informal (Tushman & Nadler, 1978).
Table 14. Literature review on the contingent factors, their dimensions and their related coordination mechanisms					

3. Conclusion of chapter 2: toward a socio-technical change

In this chapter, I reviewed two main theories on organizational change, and then on coordination means change. In the first section, we studied how technology can trigger organizational change when the complexity of this technology evolves. However the second section takes a completely opposite direction by arguing that organization is an open system and this openness to uncertainty faced by individuals incites the organization to change the coordination means in order to fit the environment. However, according to (Markus & Robey, 1988), neither provides a good analysis of the complexities of the organizational change and calls for studying the it according to an emergent perspective in which organizational change does not unilaterally but from a dynamic interaction between technology and organization.

This emergent perspective is none other than the socio-technical perspective (Bostrom & Heinen, 1977) that seeks to explain first why focusing on just one side of the organizational change (technical) leads to failure in the use of information systems in organizations (see next figure)

- Proposition 1: a technical change decreases the performance of the organization

This theory explains also that when socio-technical change is implemented, many problems and conflicts are avoided and organizational performance increases:

- Proposition 2: a socio-technical change increases the performance of the organization

In what follows, the aim is then to qualitatively verify each proposition.

CHAPTER 3. WHY USE A CASE STUDY AS METHODOLOGY?

As a general rule, the researcher has to choose among three major approaches: positive, interpretative and critical, in order to conduct his research. In this thesis, I use the critical approach, which requires either ethnographical or historical methodology. In this thesis I do not use either, but a new one known as case study research developed by Yin (2003) and inspired by a view of history: "*history and historicity first raised my consciousness regarding the importance of methodology in the social sciences*" XV preface (Yin, 2003).

This methodology is very close to history because they share certain common dimensions such as: the formulation of questions or the way behavioral events are controlled (see table 15). However, there is a difference that widens the scope of historical methodology as it also focuses on contemporary events. This makes a case study a fully-fledged methodology and different from the historical one (see table 15), and defined as: "*a how or why question is being asked about a contemporary set of events, over which the investigator, has little or no control*" (p. 9).

Strategy	Form of research question	Requires control of behavioral events	Focus on contemporary events
Experiments	How, Why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival analysis	Who, what, where, how many, how much?	No	Yes/no
History	How, Why?	No	No
Case study	How, Why?	No	Yes

Table 15. Relevant situations for different research strategies (COSMOS Corporation cited in (Yin, 2003))

According to (Yin, 2003), arguing that this thesis applies to case study methodology is not enough, but can be justified through three dimensions: defining, designing and conducting the case study. Each dimension will be discussed in a separate section.

1. Section 1 Case Study Definition

This paragraph is about the justification of case study use. Yin proposes that this methodology can only be used when five conditions are reunited. These conditions will be discussed below.

1.1. Defining a case study question

First of all, Yin argues that case study methodology is suitable only for research questions beginning by how or why. This initial condition is met because our central research question is:

How and why does this technical change (and subsequent coordination change) lead to decreased organizational performance?

The aim of this study is to measure the consequences of information technology, whether positive or negative, intended or unintended on the organizational performance. Asking this type of question is not enough to justify the use of case study strategy because the historical one also uses the same type of questions. So something else is needed in order to justify case study use. However, and before starting this type of discussion, we need first to discuss how the survey and experimental strategies are not at all appropriate for this type of question.

1- Why survey and experiment strategies are not conceivable for our research questions?

In order to justify that, I use Markus & Robey (1988)'s explanation because it provides a well formulated justification. In fact, they regroup these strategies under a single theory, the theory of variance (see table 16 for a detailed analysis). The authors add that this theory conceives the antecedents as sufficient enough to explain outcomes that are invariable and predicable. However, in relation with our research question and the theory in use, the outcome shows some variability. That's why a process theory is required in this case; this theory allows a better explanation of how and why of the outcomes occur when they occur.

	VARIANCE THEORY	**PROCESS THEORY**
ROLE OF TIME	Static	Longitudinal
DEFINITION	The cause is necessary and sufficient for the outcome	Causation consists of necessary conditions in sequence, chance and random events play a role.
ASSUMPTIONS	Outcome will inevitably occur when necessary and sufficient conditions are present	Outcomes may not occur (even when conditions are present)
ELEMENTS	Discrete entities	Discrete outcomes
LOGICAL FORM	If X, then Y; if more X, then more Y	If not X, then not Y; cannot be extended to "more X" or more Y

Table 16. Logical structure (Markus & Robey, 1988)

2- Why historical strategy is not conceivable for our research question

Neither is historical strategy suitable for research questions related to contemporary events, which is our case. In fact, this research is concerned with recent technology known as mobile/ ubiquitous technology that has become more and more widely used by the service companies.

"*During the e-business boom businesses began to use the Internet to change the ways in which they reach out to their customers. This has primarily been through Web sites that people access. The move to ubiquitous computing where we can interact with a service through a product rather than a PC or phone will radically change the nature of the customer relationship. As businesses strive to achieve ever more intimate customer relationships, it becomes evident that content and interaction modes appropriate for past channels no longer suffice. If we take seriously the idea of a relationship with a customer, we must heed to the same characteristics to foster relationships in other areas of our lives: awareness, accessibility and responsiveness*." (Fano & Gershman, 2002)

Together, these two points justify our use of case study strategy instead of the survey or experimental and historical strategies.

1.2. Defining "significant" case study questions

In this step, Yin recommends identification of two aspects: the general thematic and the three research questions related to our initial problematic. In relation to the first dimension, the general topic of this thesis is **change**. Once this thematic is identified, it is easy now to identify the three research questions related to it (see quotation):

1. *What is technical change?*
2. *Is there another type of change better than technical change?*
3. *How and why is this new type of change is better than the technical one?*

Box 1. What do we mean by coordination?

" Coordination is one element but there is a reason why we need it. The need for coordination in itself must be explained. Coordination is when we haven't succeeded in terms of process. Then there are several levels: team or interpersonal organization…"
"That's what's interesting for me in the results of your study: coordination, what is it today? Why we do we have to do it? How efficient is it, that's the quantitative aspect. How is it quantitatively efficient? How can we know?"

Moreover, Yin argues that researchers using case studies have to respond to three questions at this stage:

1. *How do you justify the significance of your study to colleagues?*

The main theoretical advance of this study is to overcome deterministic logic in studying the relationship between technology and organizational change. More precisely, the aim of this study is to shift from the technological and organizational imperatives toward an emergent perspective in which change is not related to single entities like technologies or agents but results from a complex interaction between the two aspects.

2. *Are you advancing some major theory?*

The major theory used to study the role of technology in coordination is the socio-technical theory. However, this theory is not yet well known or used adequately in the organization.

3. *Have you discovered something rare?*

The rare results discovered by undertaking this case study are related to the fact that there are some processes that do not fit the intended technical changes. In short, the results of this research show two possibilities: the ways that this change in coordination is either positive or negative; in others words, we could reveal two more possibilities: going beyond coordination boundaries and the limits of coordination.

Box 1. Going beyond coordination boundaries

"If we like someone, we will go beyond what is prescribed by the rules of organization. That's what we need to look at. It can be productive, limited and not necessarily reproducible, that's why it can step over boundaries."

Box 2. The limits of coordination

"Afterwards there is a phenomenon of exhaustion. You compensate and if you continue to compensate all the time, after a while you'll not do more.

You'll have either natural coordination designed upstream or it will be transferred to people and sorted out by them. How efficient is coordination? How far can coordination go? I can count the five fingers on my hand but when there are more I can't work it. I can't coordinate more than five people, after that it becomes, in my opinion, quantitative. You must find the asymptote. In my opinion, that's what needed. " (C3P manager)

1.3. Examining case studies used for teaching purposes

At this stage Yin argues that we should take a look at some related teaching cases in order to compare their development objectives to the objective of this case study. This is why I took a look at two textbooks in relationship with mobile applications, developed for and used by, the technicians working in US telecommunication companies (see table 17).

	(Evans, 2002)[20]	(Faigen, Fridman, & Emmett, 2002)
Company	ADC Telecommunications	Bell South Telecommunications
Solution	Wireless access to order status information	Access up-to-the minute customer service and network status information
Business Driver	Costs saving Competitive advantage	Competitive advantage
Benefits	Time saving	Shortening transaction times

Table 17. The study of the FFA technology in teaching cases.

The resulting analysis shows that both cases highlight the importance of their target users, the choice of technology, and the benefits of the use of these technologies. In this way the case studies used for teaching are represented like any commercial description of a technological product present in any web site of any technological designer. They are so because they are more concerned with the way that these technologies improve the actual processes than with the ways these processes work or even the challenges that the use of these technologies implies for these processes.

1.4. Defining different types of case study used for research purposes

Yin argues that the three following approaches can be used for the development of case study: descriptive, explanatory and exploratory. In this thesis, I use the first one. By choosing this type of design I fulfill theoretical categories developed in the previous chapter and provide examples in relation to these propositions.

2. Section 2 Case Study Design

In this section, I discuss all the steps recommended by Yin for the design of the case study.

[20] For further details of this case please refer to the Annex 1.

2.1. The unit of analysis

Markus & Robey (1988) argues that in order to study the relationship between information technology and organizational change, a selection of a three different levels of analysis are required: individual, organizations, and society. They add that those levels can be classified into two main categories: the macro and the micro levels. The main difference between these two levels of analysis is related to their preference for the causal structure. In fact the first level of analysis "*explains phenomena by referring only to macro-level concepts*" by using global structure in order to explain social phenomena and thus neglecting individual dimensions like attitudes, intentions, etc.

On the other hand, the micro-level of analysis emphasizes individual and small group analysis at the expense of the collective aspect because they argue that it's only the individual who can act and not the group because they are only comprised of individuals. The limit imposed on this type of analysis is related to "logical fallacy" in which logic is related only to concepts that are just in people's minds.

Because information technology is not related to just one of these levels of analysis, both level of analysis must be blended together. In doing so "*researchers can explore the dynamic interplay among individuals, technology, and larger social structures*."

2.2. Defining the case study

After choosing the unit of analysis of the case study, it's time to define its nature. Yin develops a framework according to which the case is chosen. This framework is developed on the basis of two dimensions:

- **Single vs. multiple**: when a single case design is selected, some arguments must appear as justification: testing a well-formulated theory, uniqueness, representativeness, revelatory, or longitudinal. However, when the design concerns multiple cases, the arguments should be related to replication logic.
- **Holistic vs. embedded**: the difference between the two dimensions is related to the number of units of analysis that are included within a case. Holistic refers to a case study implying just one unit of analysis and it's generally used when no logical subunit can be identified or when the theory used is holistic in nature. However the use of this strategy has two limits. The first one is that it ignores the details of phenomena that can be provided by the case. The second one is that in the course of the study the nature of the case may change and this will be accompanied by a

change of research design. In order to avoid this problem, the embedded case study may be an appropriate strategy for undertaking case study research. This strategy has, in turn, a limit, which is the difficulty in shifting attention from the subunit level to the larger unit of analysis.

	Single case designs	**Multiple-case designs**
Holistic		France Télécom Case Study
Embedded		

Table 18. Basic types of design for case studies (COSMOS Corporation cited in (Yin, 2003))

In line with the framework developed by Yin, the nature of our case is a multiple-holistic one (see table above). This choice will be justified by what follows in terms of the **criticality** of the case and its **representativeness**.

2.2.1. The representativeness of the case regarding the After Sale Process

France Télécom represents the After Sales process very well. I use the model developed by Ives & Vitale (1988) as a means to analyze the case and justify that.

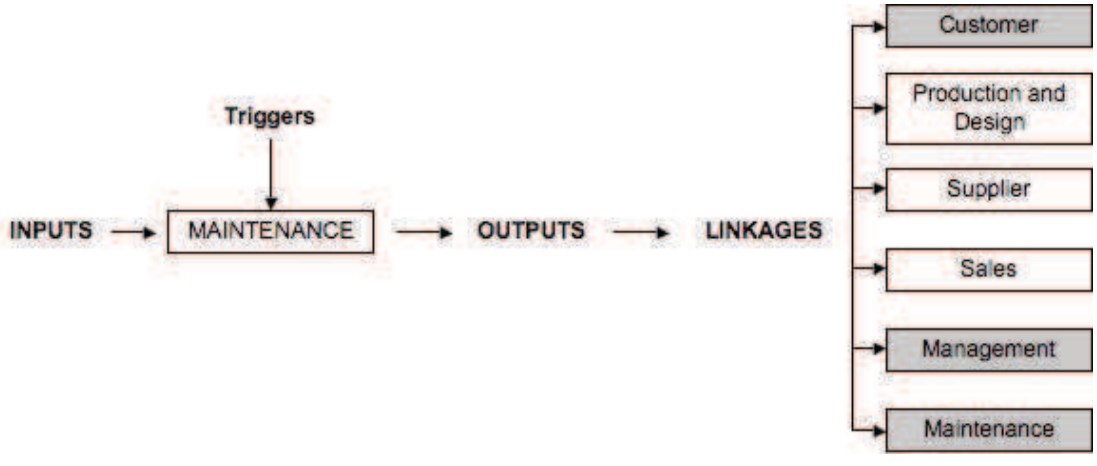


Figure 20. Key Linkages with Maintenance Process (Ives & Vitale, 1988)

2.2.1.1. Input + trigger → Process

The entire field study was undertaken within a France Télécom (FT)[21] entity called Unit of Intervention of the Alpes (UI Alpes) at Grenoble. Before talking about this UI, I must first explain what FT is. In a nutshell, FT is a large international telecommunication company based in France. It evolved to this profile due to multiple cooperation strategies with existing local companies and by taking over the existing Telecommunication Company. As a result, the activities contribute significantly to the incomes earned every year. They represent 56,3% of 50.4 billion euros earned in 2009 and are distributed over many countries: 9.9% in Great Britain, 7.5% in Spain, 7.4% in Poland, and 15.6% in the rest of the world through individual client accounts, 13.9% was generated by corporate contracts and 1.9% by international operating agreements and shared services. In sum, FT offers services to 193 million customers in 32 countries: 132.6 million customers use their mobile services and 13.5 million customers have the benefit of Internet services.

Despite this globalization and growth strategy from the outside its frontiers, the French market is still the dominant preoccupation for FT management because it represents the major income of this company in comparison with all the other countries: 43,7% of the total income earned in 2009. In this market, FT offers three types of product sold to its customers since 2006, under the brand name of Orange:

- Mobile phones: simple communication, 3G services, Mobile Internet Services like mobile Internet, mobile e-mail…
- Universal service: concerning all the services related to analogous phone lines.
- Multi-services: all products related to high-speed connections: Max ADSL2+, IP services, TV on Internet…

These products are sold using different channels such us E-commerce sites or commercial agencies distributed over the country. Once sold, and regardless of the product purchased, an After Sales Service (ASS) is available to all FT's customers encountering problems or breakdowns. This ASS can be reached only by phone call. More precisely, the customer must pass through a call center, called the Unit for

[21] In this introduction, and moving from the FT case to the UI Alpes I take a shortcut to get to the UI Alpes from the France Télécom Group otherwise I should drown in the organization structure before getting to UI Alpes.

Technical Assistance (UAT), first. However they have to dial a specific number for each product in order to get in touch with the right service[22]. If the problem concerns their phone line they call 1013 or if they're residential customers, 1015 if they're professional ones. If the problem concerns Internet Services, residential customers call 3900 and professional customers call 3901. The call center agent tests the customer's line at a distance. This remote test work is sent as an electrical current that goes through the network and allows the agent to identify and pre-localize the problem within the network. After that, it generates a general intervention request that is sent to Customer Service Support and after global testing the agent generates an intervention request that goes to the ASS unit.

As in the cases of the software hotline, the operators here have to work at distance using many tools allowing remote diagnostic and problem-solving. In order report a given problem different software, connected at distance to the customer installation or product, is used. There is an attempt at solving the problem at distance, using available software, which is the case under study. However, and unlike the case of the hotline, this remote problem-solving is no longer possible when the technician cannot figure out the problem or finds that the problem is located in the field[23]. In these cases, a technician's intervention on site is required, but these interventions are limited to problems related to or occurring at the level of the phone lines and Internet services, which is the case profile of this study. Furthermore, these interventions will not be transmitted directly from the call center to the technicians but must pass through another entity known as the dispatcher, who first receives the intervention requests from the call center and then sends them to the technicians after the appropriate analysis.

In sum, the ASS that FT provides for its customers involves three main actors after the customer's call and until he gets his failure fixed: the hotline, the dispatcher and the technician (see figure 21). By defining this chain of an ASS, I'm now able to situate the

[22] They are located in France as well as in Tunisia and in Morocco. Having one of them is really a matter of chance for the customer because it depends on different criteria like the day or the hour of the call or the waiting list at that moment. Despite this delocalization, and contrary to other operators, FT keeps a lot of this activity in France.

[23] To locate the problem in the network, the operators at the hotline use some specific software that allows exact detection of the problem and where it is located in the network. When confirmed by software, they know that they can't do any more and that on-site intervention is required.

Unit of Intervention in which the field study was conducted. This unit is mostly responsible for the entire range of on-site interventions (to which they owe their name: Unit of Intervention), contrary to the hotline that tries to fix the problem remotely. In this way, the UI covers the entire area of work beginning from the intervention request up to the failure repair (see figure 21). More precisely, this UI includes two major actors: dispatchers and technicians[24]. Only the technicians must be included in this unit as they are the ones that work outside at the customer locations for the actual intervention. The dispatchers are generally located together in the headquarters of the UI and coordinate all these technicians remotely. In this way there are two entities, one that is closest to the customers and the other acting as an interface between the technicians and customers in the sector covered

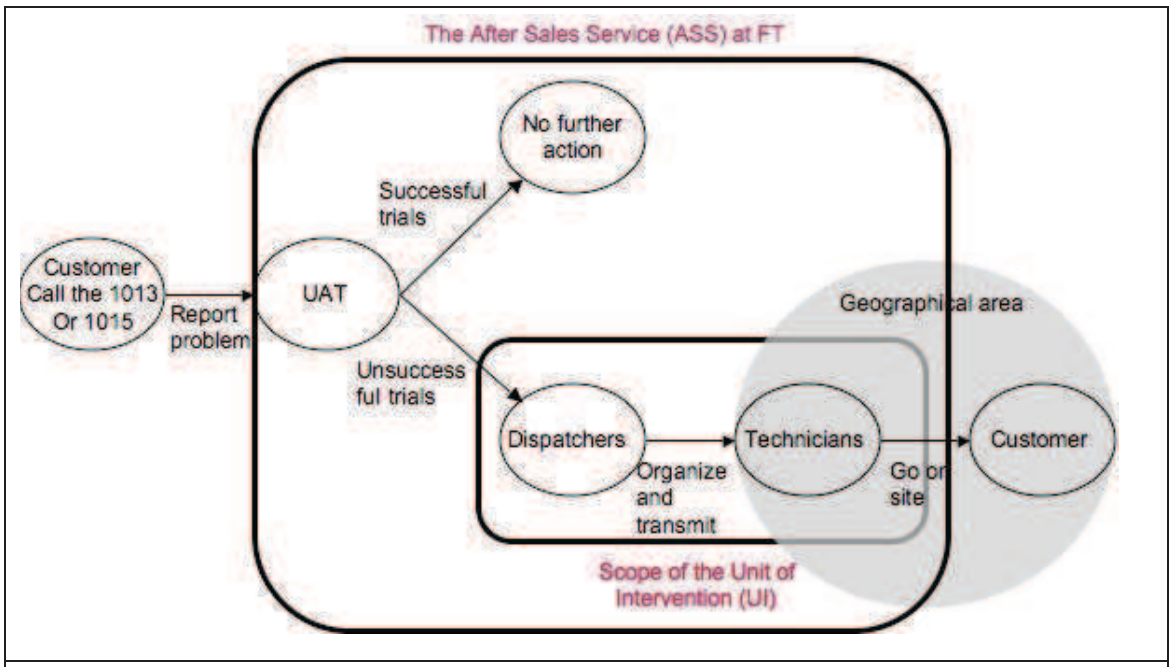


Figure 21. After Sales Support process at France Telecom and the place of the Units of Intervention within the entire process (Source: Personal[25])

[24] For a simplification purposes, I just included two main actors: dispatchers and technicians to introduce the Unit of Intervention structure. However, in reality their structure is more complex than that.

[25] In what follows, I use the reference of Personal or Internal documents to distinguish between the schema developed by myself (through my own analysis) and UI Alpes for documents from France Télécom.

The process described partly fits in the larger rounded rectangle in the figure above, with what is known as Mobile Business Process (MBP) defined as the "*one that consists of one or more activities being performed at an uncertain location and requiring* ***the worker to be mobile***" (Alag 2006). According to Gruhn et al. (2007), MBP is composed of three elements:

- *Enterprise*: an entity that requires the execution of mobile tasks.
- *Headquarters*: coordinators of the mobile tasks.
- *Mobile workers*: workers who accomplish the mobile tasks.

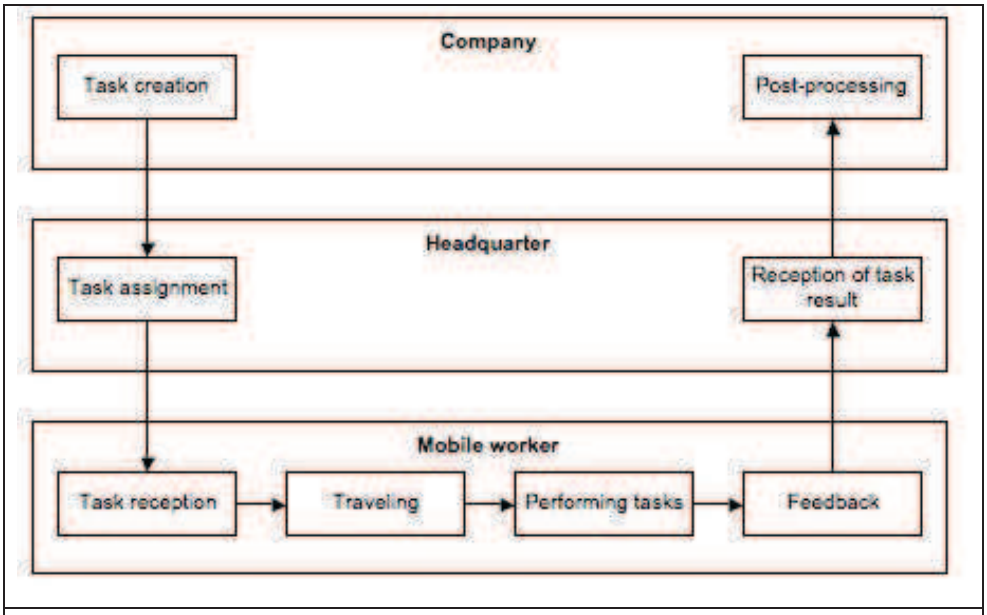


Figure 22. Mobile Business Process (Gruhn et al. 2007)

The main characteristic of this mobile business process is related to the first step, task creation. In fact, the task is completely under control and can be mainly planned in advance by the company. This is the case, for example, for the sales representative who must plan his work in advance before going to the customers, by calling and making appointments. Such control of the work charge explains why the activities of planning and visiting are often carried out by the same employees.

In connection with (Argote, 1982)'s mode of coordination, these types of mobile workers mainly use programmed coordination because they face a low level of input uncertainty. This, however, is not the case for the France Télécom process because

customers can call at any time in the day 24h a day, 7 days a week, to report an equipment breakdown and ask for repair work. In this way, the input uncertainty is very high at France Télécom and the necessary coordination is accomplished only through non-programmed means; that is why there are many actors.

This makes the France Télécom case different from the sales force and includes them within the field force category. This schedule possibility is exactly what makes the work of the sales force different from that of the field force who cannot anticipate the work-load that will arrive at any given time (Rodina et al., 2003). A field force is composed of employees working away from their base of operations while performing their job processes. (Barnes et al. 2006). As a consequence, they have to spend a significant part of their time communicating with peers and performing large and collective tasks (Breu et al. 2005).

In this way the FT enters into the category of the Field Force. Moreover, the latter includes many types of workers and industries performing their work away from their offices and shops (Kornak, Teutloff, & Welin-Berger, 2004; Trentham & Scholl, 2008; Viehland & Yang, 2007). Several industries utilize field services (Evans 2002; Rodina et al. 2003) such as: building repair work, IT infrastructure, and law enforcement. That's why when I asked a team leader about the specificity of the service, he was surprised by my question and he could not immediately provide an explanation; but once he started thinking about it, he was able to answer (see box 3).

Box 3. The representativeness of the case regarding the field force

Me: How do the technologies in use help you to manage your technicians at distance?

Technician team leader: It helps us, that's all I know.

Me: Yes, But I want to know how, I mean, without the technology, for example, what you cannot accomplish.

Technician team leader: But there's something else. I think that a workload has always existed. When you buy the material from Leroy Merlin, for example, they have a truck that will deliver it to people but they have a program so they know that on Monday morning the truck will be here, on Tuesday afternoon it will be there and so on. Here it is the same, you must know where your people are in order to know how to dispatch them according to the geographic locations of the work. If you want, the workload serves as an interface. It is crucial that the person who will receive the customer call and can fix it and we must know who's available and when it's possible. I think that what exists in France Télécom exists everywhere else. Well, I see that all those who deliver frozen food, also for Darty, when they deliver something to a customer. It's the same thing everywhere. Well, as long as you have people to manage, we have to get an overview and know who's where. France Télécom is not specific. Well, it seems to me that we agree on that, don't we?

Me: I don't know. I haven't seen other companies so I do not know.

Technician team leader: Yes, but even so…

Me: Yes I understand but this vision it is in relation with dispatching.

Technician team leader: Dispatching is everywhere. It's the same with firemen. Well, all that I would like to say is that you have to know where your guys are. It's just managing people

Once he finished his explanation, it was then my turn to be surprised about this response. Even more than that, I was disappointed because, contrary to my expectations, the France Télécom case is not unique in the world but a common case for all companies in France that provide a field service to their customers like the Leroy Merlin, Darty, Otis, Frozen Food, the Fire Station and a wide range of other companies and organizations This homogeneity results from the fact that all these types of activity

are now equipping their force with a wireless technology known as Wireless Field Force Automation (Barnes et al., 2006; Rangone & Renga, 2006) and its use allows real-time support of ordering, scheduling, supervising and reporting in the field (Olofsson & Emborg, 2004).

2.2.1.2. Process → Outputs

2.2.1.2.1. Customer Linkage

France Telecom uses customer satisfaction as a means to measure performance and show the reliability of its service. This criterion is known as the GTR, a performance benchmark called "Guaranteed Time of Repair", and defined as the contractual period in which an accidentally interrupted service must be repaired (see the annex 2). This criterion is well known in the After Sales Service literatures as the "down-time" (Agnihothri et al., 2002) or "machine downtime"(Hill, 1992), which is defined as "*the time between the request for service and completion of the service*" (Agnihothri et al., 2002) and used to divide industrial/professional activities into three groups: CHECK

- Delivery and collection such as package and mail services and garbage collection,
- Emergency services such as police, fire and ambulance. This group can be further sub-divided into three groups: crisis intervention, protection and surveillance, and investigation and instructions. This is based on urgency, frequency and the number of information exchanges (Bazijanec et al. 2004).
- After Sales service such as installation, maintenance and repair.

Furthermore, they divide down time into response time and on-site time. Response time is the time between the request for service and the arrival of the technician at the customer location. On-site time is the time spent at the customer site to provide the required service. They used this dimension in order to classify the different types of After Sales Services. However, the pick up/delivery activities, service response time and on-site time are not taken into consideration because the service can be scheduled in advance and the on-site time is not significant. Quite the opposite is true for emergency services as rapid response time is critical while on-site time is not taken into consideration thereafter. A third and still different scenario exists, that of after sales

service response time where both response time and on site-time are considered important.

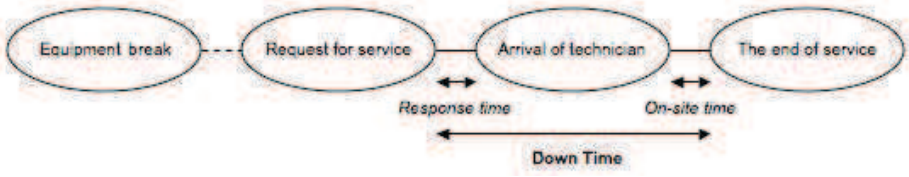


Figure 23. The differences between Down time, Response time and On-site time (adapted from (Agnihothri et al., 2002))

All FT customers have the advantage of their contract. However, depending upon whether they are professional or private clients, and the contract subscription, the guaranteed repair time will vary. FT proposes two types of contract depending on the nature of the customer:

- **Public customers**: Standard contract for all customers. In general FT has 48 hours to repair any non-functioning service.
- **Professional customers**: Including doctors, nurses, restaurants, etc…. There are three contract types: 4-hour, 8-hour or 24-hour repair guarantees.

The timer starts running when the customer reports his problem to the Technical Assistance Unit and continues to run until the repair is completed, but only during business hours. For example, if a customer with a 4-hour repair contract reports a problem at 5 pm Monday evening, the timer will run until 6pm on Monday, and the next day the repair work must be completed in the first three hours after starting work on Tuesday morning at 8 am. In case of failure to respect the 4-hour contract the customer can claim a fixed penalty from FT and receive a free month of normal service. To benefit from this possibility, the customer must send a letter to FT reporting the lack of contract fulfillment.

This type of contract allows France Telecom to measure the service performance of all its UI in France. The daily objective is set at 75% of GTR, meaning that 75% of the intervention requests must be repaired according to their respective contracts. In this way, this criterion allows FT to standardize the output and establish a competition logic

between them. This could be illustrated by the following observation when the UI has not obtained good result during the day:

Box. 4 Intervention of the director of the UI Alpes

On February 10th 2010, at 10:30 am when I was interviewing the IS administrator about FT IS, the director of the UI Alpes, where the study was conducted) came into the dispatchers' center in order to greet all the dispatchers. When, later I asked a dispatcher, out of curiosity, why she had come, she told me that yesterday their UI had had the worst performance rate among all the UI in the country and she had come in order to motivate all the dispatchers to improve this performance.

2.2.1.3. Management and Maintenance Personnel Linkages

In addition to measuring customer satisfaction, the introduction of nomadic computing within France Télécom has allowed the measuring of the technicians' performance individually and the establishment of specific objectives for their managers.

1- **Fidelo rate**: this indicator measures whether the technician is complying to real-time work. In fact the technician should inform about the state of the intervention within 180 minutes of the completion of the activity, otherwise his Fidelo rate will not be in conformity.

2- **Nomadic rate**: as its name indicates, this measures the number of times the technician goes to the distributor in order to get his workload. If this rate increases the performance of the technicians decreases.

3- **Off contract services:** this indicator gives the number sales by the technicians, ie additional activities that are not included within the initial contract but charged to the customer, like traveling costs, materials, additional repairs, etc.

4- **TIR efficiency:** it allows the comparison between the time initially planned for the technician and the time actually taken.

5- **Hours produced by TIR**: It provides a comparison between the number of hours actually performed by the technician and that provided in the reference table in order to really know his efficiency

6- **The number of interventions by TIR**: it indicates the number of interventions done by the technician per day.

7- **TRGTRUI**: it is used to measure the conformity rate to the GTR.
8- **TRDC**: it indicates whether the technician complied with the contractual date regarding the equipment.

By justifying how the case of France Télécom satisfactorily fits well with Ives & Vitale (1988)'s model, I can argue that this case is representative of the Maintenance and After Sales Services.

2.2.2. Critical case

The aim of this section is to present the entire IS of France Telecom. As shown in the next figure, the IS at France Télécom is very complex because it includes multiple components. In an attempt at simplification, I regrouped these parts into four main categories:

- Applications for collecting interventions from different software elements used by the call centers;
- Applications for managing received interventions: those at the center of this Information Systems is called Gestion de Plans de Charge (GPC), or Workload Management (WLM) in English);
- Applications for receiving and managing the interventions and those using the interventions, allowing for the reception of planned interventions;
- Other applications: those providing statistics and controls.

2.2.2.1. Applications for collecting interventions

These are the applications via which all the intervention requests are recorded and transmitted to the GPC application. These interventions concern all types of intervention, whether production, maintenance or after sales.

2.2.2.1.1. CRISTAL and AGATE

These applications are concerned with interventions requiring the production of new phone lines for private or professional (companies) clients. In this case, these clients should make a request for a new phone line to Orange. The application dedicated to managing the requests coming from private customers is CRISTAL and the one dedicated to professionals is AGATE. All these intervention requests are catered for by

these two applications. Before their transmission to GPC, the recorded information must pass through a database called 42C in which all customer information is recorded.

2.2.2.1.2. SPAS

The procedure is different for customers of SPAS who already have France Télécom phone lines and will call the hotline in order to report a breakdown, whether of a simple phone line or of the dial-up connection. Moreover, and before entering a final intervention request in SPAS, the operators have to use some remote control to fix the problem from a distance and avoid a wasteful technician intervention. However, and if they don't succeed in their task, they finally use SPAS in order to create a new intervention request. Once entered, this information passes through a database called 20H before coming to GPC. SPAS is also used for problems related to high-speed access but the data collected must pass through OCEANE, (a database for all high-speed access customers), before arriving at GPC.

By the time it arrives at GPC, the intervention request contains all the information recorded by the operator and the remote operations he has carried out.

2.2.2.1.3. ARTEMIS

Concerns all the intervention requests related to high-speed access and micro-communication service like TV on-line. The transmission of data from the ARTEMIS to GPC passes through an application called 49W.

2.2.2.1.4. SIG and QRL

Both applications are used by the dispatchers following a call from the technicians concerning an uncompleted intervention, and for rescheduling a new intervention. However, their use differs according to the operating state of the customer's installation when the technician asks for a new intervention. In fact when the customer's installation is still not working, SIG must be used in order to create a new intervention. However when the customer is working but finds that a new maintenance intervention needs to be scheduled in order improve or anticipate a future problem, QRL application must be used for the creation of the subsequent intervention.

2.2.2.1.5. OCEANE

OCEANE is an application that collects the intervention requests proceeding from three different sources:

- OCEANE is not only used for the after-sales interventions but it is also used for the production ones. However unlike CRISTAL and AGATE, which concern the production of simple phone lines, the production here concerns a high-speed connection and micro-communication service.
- FT leases its lines to other operators like FREE or Bouygues Telecom, SFR, etc. In this case when these operators have a problem or when they would like to make a request for leasing a new line from FT they must call a hotline called GAMOT dedicated to those operators.
- The third call center for collecting intervention requests from companies is known as Business Market. However not all the interventions entered there are transmitted automatically to OCEANE due to a problem of compatibility.

Once entered into OCEANE, all these interventions, whether concerned with maintenance or production, will pass through the 21W database before their transmission to GPC.

2.2.2.1.6. GIN

GIN is used when an intervention request could not, due to incompatibility, be transmitted automatically from a given application to GPC and has to be introduced manually to GPC.

2.2.2.2. Application for managing intervention: GPC

Once collected via the above application, all the interventions next come to GPC, but before their arrival they undergo a kind of automatic dispatching, which directs the interventions to the precise Unit of Intervention. This routing is based on two major criteria:

- **Geographical area**: for example, the intervention request coming from Annemasse is not put into the same Unit of Intervention as the ones coming from Voiron.
- **Product**: this selection allows the division of a geographical area into numerous other Units of Intervention based on specific products: residential and professional.

However this division is not always applied because sometimes all the products are grouped together within the same Unit of Intervention.

The use of these criteria allows the division of the three departments included within the UI Alpes: Isère, Savoie and Haute Savoie into multiple Units of Intervention (see annex 3). These units are then distributed between the dispatchers, who will each be responsible for two or three Units of Intervention.
Finally, automatic dispatching allows the dispatcher responsible for some Units of Intervention to receive only the interventions attributed to his Unit of Intervention.

After automatic dispatching, manual dispatching is carried out by the use of GPC which is divided into two parts. In the top half, it is the "Bandeau" where all the interventions are received and displayed. In the bottom half, it is the technicians' workload. More precisely, this level is divided into several columns, each one representing a technician. In addition, the latter are codified in a different way, according to their company. The code for FT technicians is the three first letters of their surname. For example, the name DUPONT is coded DUP in the list. However, if this name is also the name of subcontractor's technician, DUPOND, he would be coded as D03. Thus the codification here is based on the first letter of the name with the addition of two numbers (in D03, I used two random numbers after D the first letter of the name of Dupont). In this way the dispatcher can see the technicians home company at a glance.
Disposing of these two elements, the interventions on one hand, and the technician on the other, the dispatcher must now open-analyze one-by-one interventions and affect them to the appropriate technician in with different instructions: GTR (the contract type the customer is subscribed to), the profession of the customer, etc.

2.2.2.3. Application for receiving an intervention

2.2.2.3.1. E-TECH

Once planned, the workload will be transmitted to the technicians via E-TECH (Electronic Technician), one of the major applications used by FT's technicians. This application is developed under a Web-based protocol, which means that the technicians can access E-TECH from any device, whether stationary or mobile, equipped with an

Internet connection. This software proposes two main functionalities[26]. It enables the technicians to access their workload initially established by their dispatchers, and to enter the state of these interventions as their work progresses in the same order as the transmitted workload. In doing so, the progress of the interventions is communicated to GPC in real-time, thus allowing the dispatchers to monitor them in real-time.

2.2.2.3.2. PIDI

To deal with its lack of human resources, compared to the high number of intervention requests coming from the customers, FT calls on subcontractors for the advantage of their resources by affecting the interventions to their technicians. However, these affected interventions don't go directly to these technicians but must transit via their dispatchers who, in turn, must reorganize those interventions so as to meet their organizational goals. The transmission of the affected interventions is done through an application called PIDI. This application was developed specifically by FT for their subcontractors exterior to its Information Systems in order to keep all its data secure:

> "*We don't like our subcontractors to come and work on our applications because then they can access our information system*"

Moreover this application was developed to work in two ways, either Web-mode or in direct connection with the IS subcontractor. The first solution is generally used by the subcontractors as a backup. This means that if everything works normally, subcontractors' dispatchers receive all the interventions on their own IS. However, when a breakdown occurs in their IS, they can use a Web address, as a backup system, in order to connect to PIDI and get all the interventions affected by FT's dispatchers to their technicians.

[26] Many others functionalities are enabled by this application for example, access to statistics in order to be informed about the personal productivity. But I limit the analysis to the functionalities that are in connection with GPC.
Moreover these functionalities do not vary according to the type of the device. In fact they are same whether used in a desktop or in a mobile device.

2.2.2.4. Other applications

2.2.2.4.1. Optimiseur

Optmiseur is a calculator that works separately from the GPC. When its implementation is completed, this software partially takes the work of the dispatcher. More precisely, the activity of dispatching and affecting the work provided in the "Bandeau" to the work technician will be done automatically. This brief presentation gives sufficient grasp of the applications for the purposes of the our survey but, being software, they are outside the scope of the study.

2.2.2.4.2. Statistics

2.2.2.4.2.1. ATON

This is the application responsible for statistics on GPC. However statistics are only applied to completed interventions, represented in blue. This means that these statistics cannot be applied to interventions in progress, colored in red or green, because these interventions will not disappear from GPC but are kept until they are completed and thus written in blue. On completion, these interventions are archived in the GPC for two months. During this period, the whole intervention history can be consulted. Beyond this period, however, these interventions will not appear in GPC but are kept in an application called ATON. However, and like in the GPC, the access to these archived interventions is not unlimited but restricted to one year, and beyond this period access is no longer possible. This database is then updated each month, but their files are updated daily.

2.2.2.4.2.2. GDP

GDP is another application connected to GPC and used generally in order to translate all the interventions done by the subcontractors' technicians into financial terms, in order to pay them for the work done. In other words, this application does not concern FT's technicians because when they complete their interventions they just enter the intervention code in order to show its precise place in the network, for example whether it is accomplished at line or distributor level. Like FT's technicians, the subcontractors' technicians must do the same after finishing their work. However, and unlike the FT's technicians, the subcontractors' technicians must also enter other references, for example the ASP (Articles Series Plus) codes to encrypt their intervention for

subcontractor payment. This is to say that every time they complete an intervention, it is encrypted with a price. So, by entering these codes, the subcontractors can charge FT according to the precise work done.

2.3. Defining the criteria for judging the quality of research design

Yin establishes some criteria for judging the quality of the entire research design. It is based on two dimensions: **validity and reliability**. There are three aspects that can be generated from this analysis.

- **Construct validity**: establishing correct operation measures for the concepts being studied.
- **Internal validity**: this step is only required when the type of the study is **explanatory** rather than descriptive or exploratory.
- **External validity**: it is the major weakness of the case study the generability is not allowed.
- **Reliability**: provides a tool for its future use by another researcher for its future reproduction.

For each dimension I will just mention the places where the readers can check and judge the validity and reliability of this study.

Tests	**Case study tactic**	**Phase of research in which tactic occurs**	**Place within this chapter**
Construct validity	• Use multiple sources of evidence	Data collection	Section 3
	• Establish chain of evidence	Data collection	Section 3
	• Have key informants review draft case study report	Composition	--
Internal	• Do pattern-matching	Data analysis	--

validity	• Do explanation-building	Data analysis	--
	• Address rival explanations	Data analysis	--
	• Use logic models	Data analysis	--
	• Cross-case synthesis	Data analysis	Section 3
External validity	• Use theory in single case studies	Research design	--
	• Use replication logic in multiple case studies	Research design	Section 1
Reliability	• Use case study protocol	Data collection	Section 3
	• Develop case study database	Data collection	--

Table 19. Case study tactics for four design tests and from which the study was adapted COSMOS Corporation cited in (Yin, 2003))

3. Section 3 Case study conduct

3.1. Preparation for data collection

3.1.1. Skills needed for carrying out case studies

The data required for this study was collected at the UI Alpes – France Télécom. However, I went through many preparatory steps. In December 2009, I met the deputy head of the Human Resource Department. After our meeting he put me in touch with the head of the Business Management Department. So one month later, in January 2010, I met the head of this department who accepted my undertaking this study as an internship thesis during the month of February 2010 (see the annex 5).

I think I was lucky. In general the management was pleased by the idea of my study because the timing was perfect. My introduction within the UI Alpes was less well received. In general, the management was very happy about my presence in this unit but this was not the case for the others units because they feared revelations of dysfunctions in their organization and the problem of making changes**.** The object of the study fitted well with the trend of actual changes happening within France Télécom, so, in general, the management was pleased with this opportunity of getting information which would help decide transition possibilities.

Box 5. Management interest regarding my study

C3P Manager: …Concerning this study, I think it's necessary to start from concrete cases but it's also necessary to use a little more abstraction when what's true in our organization is not always true elsewhere, but you always find the same things when you examine human relations and management. You know the situation in France Télécom; we underwent a complete turnabout in terms of policy. Policy number one was the workforce, then the activity and finally the people. People were considered the adjustment variable. Do you know what that means?

Me: Yes

C3P Manager: So, you've seen certain number of things. And then they say: "*Do it the other way round, people first*". Great! but then it is necessary to see at which level. This is the crux of the matter. So, this means that you have to change everything, or do the same and in fact, we just change a bit. You must realize that overnight, France Télécom cannot say "*We'll not take care of the shareholders*," it doesn't make sense. Then, you have to say, what about social wellbeing, and then there are the media. So it must figure in your study; these elements should be revealed. You must see things from another viewpoint.

By this internship, the management allowed me full access to all UI Alpes actors in general and to the dispatchers of the UI in particular, with whom this study was undertaken. More than giving simple access to these actors, this internship allowed me not to be considered an outsider but as fully-fledged employee, having the same status and privileges as all other FT employees: canteen, pass card for the building, traveling expenses. In this way, I was considered as a colleague when I met or worked with someone in France Télécom. In short, this status took away all the usual institutional boundaries (academic, professional) that could have hampered my relations with FT employees.

This status also helped the manager of the ASS to introduce me to his team without any problem. More precisely, he introduced me as doing a thesis internship, wanting to study their interaction with the technicians and told them to not be surprised if I came and asked them some questions during their work. After this brief presentation, he left

me alone after telling me to take a chair and sit by to any one among the dispatchers so they could explain their work to me. This fact did not disrupt the group, because they are accustomed to such standard practice for all the interns and newcomers in France Télécom. At the same time there was a newcomer from another FT service. So, I was able to start the work on the very same day.

However there are two dimensions that made my internship unusual for the dispatchers compared to newcomers and interns. Firstly, I did not try to learn to use the software like the others when they asked me to use it. Secondly, the period of learning for the internship and newcomers is limited to one week and after this period they have to start working and take their own desktop. This period is not always respected, because I saw some newcomers start working just after two or three days as watching others doing the work is boring. These unusual elements for an intern and use of the term "thesis in management" made the dispatchers distrustful regarding my coming. These feelings were expressed differently among the dispatchers. For instance, one dispatcher from the BU Local Loop told me directly when she saw me in the cafeteria that "*Your work is dangerous for us*" I also overheard this question "*What does a thesis have to do with us?*" among dispatchers talking together. This fear is not without reason. Some employees told me that they were afraid that the purpose of my work was to establish new procedures for management, which would restrict their work flexibility, whereas others were afraid about the fact that I might evaluate and supervise their daily performance. These reasons made some dispatchers displeased about my coming (see next box).

Box 6. Irritable or friendly expression of negative feelings.

Some very direct and annoyed:

"Ah this afternoon you'll go and sit with the bosses, won't you? Well, it's true, you don't need to be staying with someone all day, it's normal that you share your time with other people here. In addition, I must call my mother. Well, it'll take a quarter of an hour, and what is more, it's personal, she's in hospital. No, but you must admit that if you have some one who is behind you all the time, it's a nuisance because sometimes you want to see your staff or look at your e-mails."

Some indirectly and gently:

"For now it's quiet, you see that not much is happening. Maybe you want to go to see

other colleagues."

In reality, all the dispatchers had some uneasiness about my coming and the possible disastrous results that this study could have on their job. However, over time some changed their minds regarding my study. For this, a trusting relationship had to be established between us. Here are some strategies that I involuntarily used to build this type of relationship with dispatchers: I call them micro- and macro-strategies. I had to use my acting talents

They are things that are very simple but neglecting them could have had disastrous results for my case.

1- Macro strategy:

- *Identifying the influential actors within the group and gaining their trust*: Actors can be generally identified in two ways. First, there are those who give long speeches during the weekly meetings and are always contesting management decisions because they are always unsatisfied with them. Secondly, there are those who have union responsibility in addition to their work as a dispatcher. Once identified, I took time with them on the first days until the internship began to explain my study, its potential and its objectives. In short, I talked to them as if they were the manager that I saw at the beginning to persuade him to accept my study. I did so because these people have another type of power within the organization, the keys to access the informal organization that the managers don't have (even if they would like to). First gaining their trust was very important for further development of the study because if they found the study easy and agreeable, they would talk favorably about it, making my first contact with the dispatcher that much easier. To this end, also I tried to begin my observation with these people, as from the third day of my internship, ensuring that the observation was going well and that I was making a good impression.

- *The "cookie"(pain au chocolat[27]) technique*: In France Télécom this technique is generally used by the management to sweeten the medicine as one dispatcher said when she saw one manager coming to the Platform with a basket of "*pains au chocolat*". This means that when a new decision or new measure is to be announced that will probably not please his team, the manager comes up to sweeten or soften the announcement in

[27] The famous French breakfast delicacy.

order to reduce possible negative reactions. Even if this technique, from my observation, does not really reduce either their reactions or the aggressiveness of the message it does however, send another deeper and very important message that the management cares about them and what they feel. The same technique is used in another context but for the very same purpose. In fact, the manager supervising the group on Saturday has to buy and bring the "*pains au chocolat*" because they are not working regular business hours, so some favors underline the fact.

I used this strategy for my own purpose, which was to be closer to these actors and brought in some "*pains au chocolat*". However, unlike its use by the management, I used it to favor exchange and to show friendliness to the workers present on the Platform.

- *Identification and conforming to organizational rituals*: The work of the dispatchers begins officially at 7:30 am, so every day during my internship I was there at that time. Once there, I would take a chair and sit close to the dispatchers in order to begin my observations straightaway, without wasting time. I continued to do that until I realized that every dispatcher, when he or she came in the morning and after going to his office and opening his desktop, would do his office rounds, in order to kiss and say good morning to every one present on the Platform. When I observed that, I changed my habits and started doing the same, even though it took a long time as there were a lot of people. However, this process is not applicable for all the dispatchers as there are some that are more reserved and simply say good morning out loud to all the people present on the Platform. Then again, it does not happen for those who start working later than the others, at 9 o'clock for example, because at that time the Platform is full and it would mean interrupting work.

- *Showing my commitment regarding my study*: In fact in order to compare between different days of work, I came to observe the dispatchers, not only in regular business hours but also on Saturdays. When they saw me on these days they were surprised and little bit angry because they thought that it was the management's idea, but when I told them that I had come on my own initiative they appreciated my courage for coming at the weekend.

2- Micro-strategies

- *Establishing a friendly relationship*: I knew already that the type of study that I was undertaking required encroaching on the privacy of the dispatchers So I tried, right from the first contact to give a lot of information about my project and myself, explain the difficulties that I had encountered to gain access to this company; it was reassuring for them.

- *Establishing a kind of family relationship more than a just a colleague-style friendship*: it's true that having the status of a colleague would sometimes give me access to private information as is shared between colleagues without any problem.

Box 7. Introduction to their private in addition to their professional work

Dispatcher 1: I want to ask Marie-Cécile, something off the record. What I have done with the number, it makes me nervous. I have a colleague whose son is a customer of free (rival company) and his phone is out of order but I think it's the unbundling and that's all.
Dispatcher 2: as for unbundling, we only ensure the line support, after that…
Dispatcher 1: Normally we can't call him on the line.
Dispatcher 2: Normally you have either an engaged tone or no tone at all.
Dispatcher 1: I don't know. I'll try
Dispatcher 2: Try to test the line but you cannot even
Dispatcher 1: but can't, total unbundled. It makes me nervous because she is not at France Télécom and
Dispatcher 2: normally, this where she should start. Even if it GAMOT, it's Free that will send it.
Dispatcher 1: this is a wrong number
Dispatcher 2: we can not come out a der
Dispatcher 1: we can not come out a failure
Dispatcher 2: it is to the operator to ask. It's true that the operators do not go fast and the customer is fed up with
Dispatcher 1: I would just like to ask if I can do
Dispatcher 2: I'm no even sure that you can make a sig

Dispatcher 1: No I can't for the unbundled

Dispatcher 2: it should pass through GAMOT

Dispatcher 1: I can't and this it escapes me a bit

In short, the dissociation between private and professional spheres does not matter in our case, it's something natural within our study context. However, what is revealed is another new type of dissociation that is mostly related to work: the dissociation between private-public spheres of work. In fact, the dispatchers in our case keep some secrets about their specific way of working; either they don't ask for or share any information about the way the others do their work because each one is responsible for a specific geographical area That's why having just a friendly relationship with the dispatchers did not allow me to access this type of information, which is the aim of my case study. Thus another type of relationship that I would call "filial" had to be used in order to collect these crucial data, with me taking the role of the child.

I chose this word because I was like a kid that starts speaking and seeing everything new in the world around him and wishing to learn everything, to touch to everything. To do so, he asks many questions about everything new around him. Sometimes he repeats the same questions many times in order to remove doubts and interiorize the responses. On the other hand, those on the "parental" side are always available to respond to these questions, being patient and responding to repetitive and even boring questions.
This is exactly what happened between me and the dispatchers when I started my data collection at France Télécom, I was like a child trying to learn this new world and the only way was just by asking his parents. For me however, new world was my France Télécom case study with many actors, many services, much software and the only people to ask were the dispatchers (see next box). However, not all the dispatchers accepted to play this role.

Box 8. A dispatcher's understanding of my position

"I understand your position because I have a daughter and I would like people to help her if she undertakes an internship like you within an organization."

- *Expressing interest regarding their work*: Given the fact that no reward mechanism, whether material or immaterial, exists at France Télécom, for the dispatcher, regarding their daily performance[28], I was able to use this lack for my own purposes by expressing my admiration when they got out of difficult situation. This fact was very much appreciated by the dispatchers because they were proud when they told me the same problem had arisen again. Sometimes they went farther because even if I was working with them, being in observation with other dispatcher, they would come and ask me if I wanted to come and follow the evolution of that case.

Once this trusting relationship is established, the majority of the dispatchers within the UI Alpes were helpful and generous, allowing me to collect all the required material to successfully carry out my case study.

3.1.2. Case Study Protocol

3.1.2.1. Overview of the case study project

See Annex 4 for viewing the project as was developed before entering France Télécom.

3.1.2.2. Case study questions

Before undertaking the case study, an interview guideline was designed in accordance with our initial problem and with the four criteria recommended by Yin:

- *General orientation of questions*: as is shown in the interview guideline, the starting questions are general in order to understand and to get familiarized with the entire process of coordination.
- *Question complexity levels*: once the general process of coordination is revealed, more detailed questions are needed for more problematic sequences in order to reveal the constraints of the actions.
- *Other data collection devices*: In the middle of the interview guidelines, I also used a table in order to classify related constraints/problems in accordance with the complex sequences.

[28] What I would like to say by this is that the reward system at France Télécom is not based at all on their daily performance but rather on a kind of Grid established by the Human Resource Department that includes many criteria like seniority…

- *Undesired confusion*: the initial design is related to an abstract level of organization, coordination, and data are collected from those directly concerned with coordination, the dispatchers, in order to understand how and why coordination works. (see next table)

		DATA COLLECTION SOURCE		Study Conclusions
		From an individual	From an organization	
Design	About an individual	Individual behavior Individual attitudes Individual perceptions	Archival records Other reported behaviors, attitudes, and perceptions	➔ If case study is an individual
	About an organization	How organization works? Why organization works?	Personnel policies Organization outcomes	➔ If case study is an organization

Table 20. Design Versus Data collection: Different Units of Analysis (Source: COSMOS Corporation in (Yin, 2003))

3.1.3. Case selection for a pilot study

In order to be geographically closer to their customer all over the country, France Telecom employs over 10 000 technicians in France. To handle this flow of technicians, FT cannot centralize the dispatching work and those at headquarters within a single structure. That's why many decentralized UI exist all over the country, having their own responsibility for the area that they are dealing with: UI Nord, UI Alsace Loraine, UI Alpes etc. which in turn include many departments. These UI, in general, should be considered as fully-fledged companies because each one of them has its own structure comprising different departments: Human resources, finance and logistics, to mention but a few. (see figure) and the director of each UI (see the next flowchart of the company of UI Alpes) has freedom regarding decision-taking, hiring, network investment, training etc. More precisely, these UI should be considered as medium-sized companies because each one of them employs many more than 249 employees (1

000 employees on average), and in which the majority of those employees are technicians.

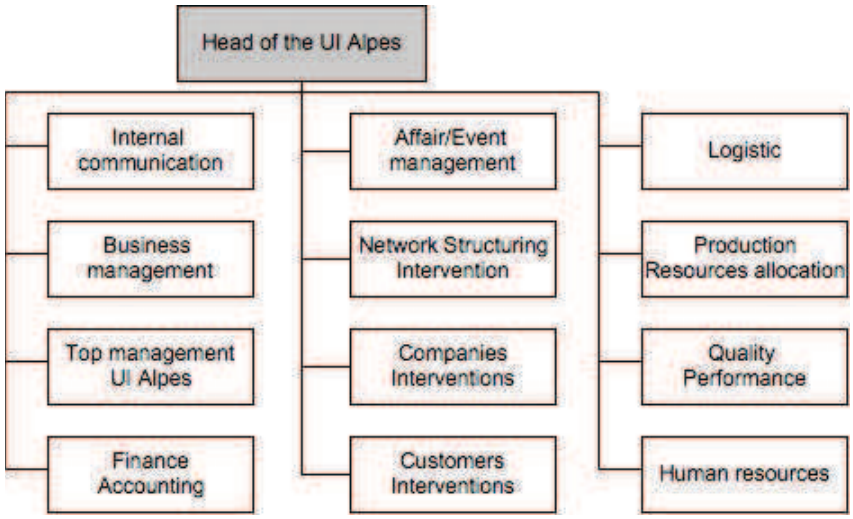
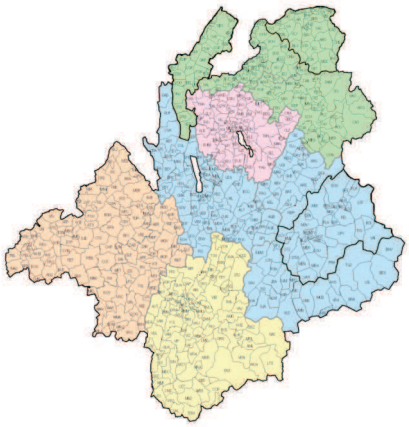


Figure 24. The flowchart of the UI Alpes (Source UI Alpes)

All the UI of the France Télécom are thus functionally similar but geographically different, with each UI responsible for a specific area. Consequently, the main difference between these UI can only be geographical, which was thus used as the unique criterion for selecting the pilot study. More precisely, the selection was based on the UI presenting the most challenging geographical area, because it allows the observation of very diverse cases. According to this criterion, it appears that the UI Alpes is the best candidate for the pilot study. Before demonstrating this, let me say two words about this UI, located in **Grenoble** and responsible for four geographical areas: **Savoie, Haute Savoie, North and South Isère**, and employs 1 200 employees, of which 600 are technicians.



Haute-Savoie: Green
Savoie: • Pink (Annecy) • Blue (Chambéry)
North-Isère: Orange
South-Isère: Yellow

The UI Alpes presents the most challenging geographical area, having the highest organizational impact, because all the departments included in this UI have to respond to one of the three conditions below:

Bad meteorological conditions: mountainous region where it snows too much. Consequently, snow restricts the technician's access when too deep or by cutting off mountain roads.

Seasonality of the activity: Each year, most of the activity at the UI Alpes is focused on ski resorts from November until March. During this period, the number of interventions greatly increases and are directed towards::

- **Professional customers**: are those with a professional activity in the ski resort such as restaurants and hotels. Sometimes, and following the repair program, the technician has to get to the installation on skis, by helicopter, 4x4, snow scooters or

ski lift. Obviously, when these cases occur, the intervention takes longer than planned.

- **Temporary events**: there are a number of *"Salons"* (Shows) and events that take place in the stations annually like the "Andros Trophy", the ski "World Cup", etc. So, in this case more lines are required thus monopolizing the technicians; this has a negative impact on the ability of the UI Alpes to respond to incoming failure complaints.

Aerial Network: in some geographical areas, the network is not buried underground like the majority; all the interventions require a work two technicians instead of one.

All the departments covered by the UI Alpes are concerned with at least one of these specificities. For example: Haute-Savoie, Savoie and South-Isère are more affected by the two first conditions, while North-Isère is concerned just by the last one.

These exceptional conditions of work at the UI Alpes make it a perfect pilot site. That's why this UI was chosen by France Télécom as a pilot site for experimenting with new software called the Optimiseur for one year. In doing so, it enables the redefinition of the software parameters to be compared to multiple parameters involved in this UI. However, and due to the complexity of the parameters to be included in this software, it has been abandoned by the UI Alpes. Despite this hitch, the software resulting from this experimental period has given birth to software that's efficient enough to be included within other UI, such as the Nice UI.

3.1.4. Data collection

In this phase, Yin finds that six sources of data can be collected within a single case. To conduct my case study, I use three major sources: **interview guidelines, participant observation** and **internal documentation** because Yin argues that we should use two sources of data collection for those undertaking a descriptive design for undertaking a case study: direct observation and ethnography. So, these techniques allowed me to gather real-time and real-life data from the field.

The data were collected over 3 months during only regular business hours. Each day was generally spent with one observed technician that I followed all day from 7:30 am until 16:30 pm or 17 pm according to their working hours established in agreement with their managers. On these days, and each time I observed the technicians doing something, I asked two main questions: *"what's happening?"* And "*What are you doing?"* By asking these two types of question, it was easy, at that stage of analysis, to codify and analyze the data because the first question was related to a description of the situation in which the technician found himself and the second one to the reasons for using this specific type of conduct. In doing so, we establish the chain of evidence required for the validity of the interpretation.

Because I used these two types of question every time and for everyone, I observed two types of reaction to repetitive questions. Some people interiorized them in such a way that I didn't have to ask them these questions every time I saw them starting to do something. They spontaneously talked about their work every time they started. However, when the situation was urgent or required an interaction with someone, they waited until the end before telling me what had happened. This cooperation made my position very comfortable.
However, this was not the case for all the people observed. In fact, there were some people who needed me to ask the same questions every time I saw them doing something. It's true that this process became very tiring and boring, for both me and the technicians, to the extent that they sometimes flew off the handle.

All the conversations and the interactions were recorded in this case and were transcribed later. However this latter step is not accomplished in the same day following the data collection. This is mostly explained by the quantity of data recorded during the day. Indeed one recorded hour required 1 day of transcription so for a whole day takes a lot of time. This fact made the process of transcription difficult within the period of the internship. So I started the transcription once I had finished.

Because I recorded each technician interaction separately, the transcribed text also takes a similar form. This means that the final transcribed text will include many transcribed separate interactions. Each sequences has a code which distinguishes it from the others because each has its own criteria. The criteria used for organizing these sequences are: the department, the site in which the observation is taking place, the technician under study, the day of the observation, and the number of sequences. So, at the end I will have this type of reference for example "(S, SA, N, 25)" that refers to the department of Savoie, Albertville Site, Nomadic technician and 25 refers to number of sequences recorded.

3.1.5. Data analysis

During the data collection, I compared myself to a kid getting into the environment of France Télécom where everything was new. However, this kid will not stay that way all his life. Over time, he will grow up by accumulating all the types of information coming

from his environment and become mature only when he is able to take position in that environment by synthesizing and analyzing things it provides. It was also my case as an intern. In fact this simple intern grew up in the France Télécom environment by accumulating the information provided from its different sources: interview, observations and internal documents. However, this intern will be transformed into a researcher, (an adult in the case of the kid), only when he takes a stand when faced with all the collected material and is able to analyze it.

To accomplish this, I use one Yin (2003)'s analytic techniques called "cross-case synthesis". In general this technique is suitable for studies involving multiple cases and our study enters into this category because it involves two cases within a single company of France Télécom, we also use this technique. This cross-case analysis, compared to analysis involving only a single case, has two benefits: the analysis is much easier than studies involving single cases, and the result is more convincing than with single cases.

Yin adds that the use of this technique varies according to the number of cases involved in the analysis. In fact when multiple cases are involved in the study, quantitative approaches must be used. However, and when this is not the case, it means that the number of cases is modest, and "word-table" techniques are required.

Because there are just two cases involved in this study, I used the second technique as a technique for pattern matching. In short this technique consists in creating individual word-tables representing a unique framework for each individual and to attributing a pattern to the entire table. Once accomplished, the work of comparison begins between all these word-tables in order to reveal their similarities and their opposition.

Yin finally warns that the analysis of these tables should be based on argumentation and interpretation rather than on numeric tallies.

4. Conclusion of chapter 3

Throughout this chapter, I have tried to justify why I specifically chose case study as a methodology. To do so, I followed the three steps recommended by Yin: **defining, designing and conducting** the case. Each step is analyzed in a separate section.

In the first section, I tried to define the case study by justifying its use as compared to other methodology and also compared to other existing theoretical frameworks developed in present-day theories.

In the second section, I developed the case design by setting the **unit of analysis**, the **nature of the case**, (whether single or multiple) and by **identifying the criteria** for the appreciation of the quality of this design.

Finally, in the last section, I developed the way the case study was conducted, from the preparation of data collection up to the way the data was analyzed.

By justifying all these steps, I'm now, able to show the results of the case study undertaken at France Télécom in the next chapter.

CHAPTER 4. FIELD FORCE AUTOMATION AND COORDINATION IN FRANCE TÉLÉCOM: ENEMIES OR ALLIES?

As discussed in the previous chapter, one of the results of this thesis is the description of the case study because, according to Yin, this should be considered as a fully-fledged research result like the two other designs: explanatory and exploratory. However, and unlike them, Yin argues that this type of design does not imply any rigorous procedure to follow for theory construction or pattern matching because it simply deals with the organization and the synthesis of the case study[29]. In short this description, and then this chapter, gives an overview of the challenges implied by the mobile technology access to information and, more precisely, the way this new access can pave the way to new interactions between actors that were previously neither possible or imaginable. In the

[29] I find that this type of case study and its design is suitable for introducing how our chosen case, France Télécom, is suited to our problematic: the relationship between the mobile technology and subsequent coordination (this will also allow me to introduce the next chapter). More precisely, I chose this type of design because, unlike the next chapter where I was restricted by a specific design and sequence, it allows freedom to describe 4 months of observation by: selecting themes, using adequate literature, telling stories, identifying problem cases, criticizing, making comments, giving advice, proposing solutions, etc. This freedom to organize and describe the social aspects in my own way is the unique motivation for devoting an entire chapter to describing the relationship between coordination and the Nomadic IS.

This flexibility to organize the entire case, and then this chapter, does not imply a haphazard approach but meets the requirements of the type of design recommended by Yin (2003 #218}: **linear analytic, comparative, chronological** and **unsequenced.**

- **Linear analytic**: each section in this chapter uses literature in order to organize the data in a meaningful way. However the place where this literature is used differs from one section to another. For example, in the first section the literature is used in the middle, at the end for the second one and at the beginning for the last one.

- Comparative: repetition of the facts in relation with the advances in the literature.

- **Chronological**: throughout these sections, I try to provide a complete history of the Information Systems within the UI ALPES, from its challenges to features available for use in and support of the work practice.

- **Unsequenced**: the order of the two sections does not matter because each section deals with a separate problem.

case of France Telecom, these new interactions occur through changes in two former mechanisms used mostly for direct interaction[30].

1. The consequences of informal interaction

Mobile technology has given FT an opportunity to reinforce the autonomy of its technicians regarding physical space. In fact, by providing unlimited geographical access to the workload from mobile devices, the technician has no further need to contact the distributor before going to the customer site, but can go directly from wherever he lives. In this way the technician's productivity is improved because he can undertake more interventions per day and costs such as traveling expenses are reduced.

In doing so, the management of FT overlooks the fact that the distributor is not just a place where the technicians can get access to their workload, but a place where they also coordinate their work. More precisely, they take advantage of their meetings in the morning to ask colleagues for possible solutions to any serious problem encountered.

In this way, the distributor is the perfect place for undertaking informal communication. However, by the introduction of mobile technology this type of coordination is removed.

2. The consequences of direct supervision

FT management also sees an opportunity to reinforce the control of the technician's individual productivity in mobile technology because it doesn't remove the actual mode of coordination, called "*standardization of the work processes*". ;the technician continues to use the documents or refer to the procedure in case of a problem encountered in the field. The introduction of mobile technology extends this old mode of coordination by giving rise to a new mode of coordination, called "*standardization of the output*", since the technician has to use this technology for all actions undertaken during his intervention: whether or not he finds the customer, when he calls up before arrival and the type of repair work carried out. Once entered by the technician, all this information will be recorded within a database, thus allowing the calculation of the performance of each technician (called *PIC Performance Individuelle Comparée* in French). This change is accompanied by something revolutionary for managers because,

[30] Two means of coordination, **mutual adjustment** and **direct supervision** are grouped into a single category called "**direct interaction**" because both are initiated by the manager or the technician and they both need face-to-face interaction. I maintain this focus in the next analysis.

regarding this calculation of a technician's performance, they must now manage their teams in order to meet a performance objective.

The management of FT is aware that a new role given to the team leaders will increase their workload. As a result, and in order to keep them focused on the productivity of their technicians, the management of FT has decided to reduce their responsibility regarding another role, activity distribution, (called direct supervision by Mintzberg) that is transferred to a new entity called "Dispatching". However, what is new is that this transfer of responsibility is not accompanied by any recognition of a formal relationship to the dispatchers supervising the technician. As a result, the distribution of the technicians' work or the direct supervision is performed informally rather than formally.

Box 9. The impact of the FFA on the role of the manager

"Originally, if you like, at that time in France Telecom, the activity (dispatching) was already carried out within the team. There was a group that was autonomous: the members of the group were responsible for the activity. There was one who took the work and distributed it to others: the direct manager: he followed the activity of each one of them, following their productivity. Today, we give the distribution of the activity to someone else, who dispatches the activity without being responsible for it." (C3P manager)

In short, the introduction of mobile technology within the technicians' communities has two major impacts on coordination that will be analyzed separately below. I will first describe the way mobile technology is used by the technician belonging to the Customer Intervention Department. Next, I'll analyze the second change, the actual organization of the dispatcher. Even if the analysis undertaken is based on a similar topic, coordination, the sources used for this description are not the same, because in the first analysis the notes are from direct observation, and in the second I'm using internal documents and interviews.

1. Section 1 Customer Intervention Department Organization: when technology and coordination become enemies and impede social progress

Before starting the presentation of this section and the way coordination is undertaken, let me say two words about FT network because it allows me[31], first of all, to situate the area of responsibility of this department in comparison with others intervening in the same network; in fact all the intervention departments were designed in order to cover the whole FT network. Secondly, it allows me to explain how and why interactions between the technicians of these departments take place.

In short, this network is divided into three parts[32]**:** Network, Local Loop and Customer Connection. The first part is the most upstream part of the network and covers all the elements right up to the distributor. The second part is the intermediary part because it covers all the wires from the distributor up to a place called Point of Concentration (PC). Finally, the last part starts from this PC up to the customer's installation.

Consequently, three intervention departments were designed in order to cover these three parts of the network, each being responsible for just one part: Intervention Network Structuring Department is responsible for the first part of the network**,** Intervention Local Loop Department is responsible for the intermediary part of the network and Customer Intervention Department is responsible for the last part of the network that relays the customer to the FT network.

In addition to sharing similar networks, all these departments apply similar hierarchical levels: Head of department, Team leader[33] and Technicians. However the main difference between them is related to the difficulty and time required for their work. In fact all the breakdowns arising in the two first parts of the network are scheduled on a

[31] Moreover, it will help me in the presentation of the other departments because it is organized so as to cover the network, to locate the Business Unit in direct relationship with the Intervention Department and with the relationship of this business unit and services located within the same department.

[32] I used the most global division of the network that is common and known by everybody in France Telecom and according to which the departments were designed, knowing that each part includes many other divisions. For example, the second part presented here is composed of two parts separated by something called SR (in French: Sous-Repartiteur) because we don't use the same type of wire on both sides of SR.

[33] Known as "Responsable de Groupe" (RDG) in France Télécom flowchart.

half-day basis while one and a half hours are attributed for problems relating to the last part of the network.

I will now focus my attention on just one department, the Customer Intervention Department, but not in isolation from the other departments, and more precisely, analyze the implications that mobile technology has for the coordination of their work. To do so, I undertook a field study lasting 3 months, on every day of which I followed the work of a technician from starting time at 8 am, until finishing time at 16:30 pm. The technicians that I observed come from different sites within a given department or sites in different departments: Isère and Haute Savoie.

In what follows I will analyze how mobile technology is used and the impact it has on coordination.

1.1. Expected consequences: the re-appearance of mutual adjustment and communities

In the introduction of this section, I talked briefly about just one mode of working known as **Nomadic**. In reality, it was not the unique mode of working for the technician because FT management kept some technicians stationary (see next flowchart in figure 25). The main difference between them is not related to those equipped with the mobile technology or not, but rather to the place where the technician has to take his car before starting work (the point of departure). In the first category of technicians the car is kept at home while in the second one the car is kept at the distributor of the France Telecom and taken in the morning from there. In what follows, I'll analyze how mobile technology is used by each category of technicians and the specific means used in order to coordinate their work.

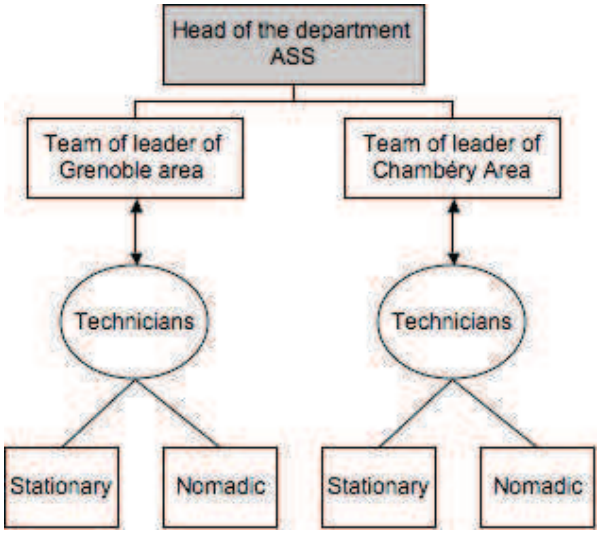


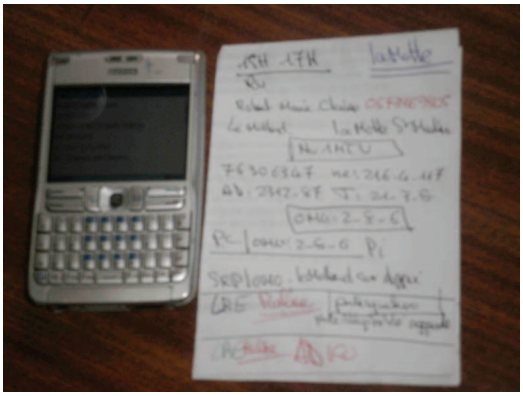
Figure 25. A simplified flowchart of the Customer intervention department

1.1.1. Nomadic work

FT management defines the nomadic worker as the one who starts work from home and goes directly to the customer site, without any intermediary steps, once they have received all the intervention requests on their mobile phone or laptop connected to their home Internet. They can do so because they can keep the FT car at home. They keep the car because they live far from the distributor where the car could be kept and also accept long distance trips if required. Like the stationary workers they need a certain amount of time before getting started in order to consult and analyze the interventions. However, unlike the latter, they undertake this task alone and in different places, sometimes in the car, or at the distributor close to a customer site. Furthermore, they don't have a printer, as do the stationary technicians, to print out the interventions, so they list all the intervention on paper in order to have an overall view. However, the way these interventions are organized on paper differs from one technician to another (see pictures below).

Once they finish using these papers, not all the technicians throw the paper away but keep them in a workbook or in the car for three months in order to keep track of what has been done and to give information either to their colleagues or their managers. In fact, in doing so they try to overcome the limits of mobile applications, for which the number of characters for comments is limited, so the technicians are unable to enter all the information about what has really been done.

Clearly, that this way of working does not favor meetings between FT technicians. However, I saw in some cases, as at the Cluse site, that some nomadic workers meet everyday in the cafeteria at 7:30 am in order to have coffee together and communicate informally.



1.1.2. Stationary work

Because they live near the distributor, FT managers have decided to keep these technicians stationary. In short, these technicians have to take the car from the parking lot of the distributor before starting work and leave it there once the work is finished. In short, they have to use it only in regular business hours, from 8am and 11h30 am and from 1h30 pm until 4h30 pm. However these technicians are allowed to keep their car at lunch time when the interventions of the morning and the afternoon are scheduled at the same place and far from the point of the departure. Over this time, and in order to avoid wasteful return trips, the technician can keep the car over lunch taken on the spot, before starting the interventions of the afternoon.

For these stationary workers, the introduction of mobile technology in their work does not really disturb their work habits because, as I observed, they still come to the distributor car park 30 minutes earlier than official time at which work begins in order to use the desktop on site. Its use is similar to mobile technology because both are equipped with the same application called E-tech. This means that they can also use the desktop in order to communicate their work, consult their workload, etc. as in the case of using a mobile device. However, the main difference which makes the desktop preferred to mobile technology, is that it is has a printer allowing them to print out their day's work schedule. Moreover, they can use the desktop with multiple applications for

advance analysis of all the interventions planned for the day that they are not able to do on their mobile devices, as well as for writing up all the additional information on the printed papers. These print-outs are preferred because notes are easily added when new information is obtained. This is also why desktop is preferred to mobile technology because multiple software to analyze the problems dealt with during the day is not available via mobile technology, the results of these analyses being then printed out.

Generally, there is just one desktop in the office that must be shared by all the stationary technicians. This means that when several technicians come there at the same time, which is always the case, they have to wait their turn. This is why some prefer to bring their laptop, also provided by FT, for similar use. However, this is not common because the majority of technicians prefer to use the shared desktop even if they have to wait a while (I observed just one person using his laptop instead of the desktop). In fact, the technicians easily accommodate to the wait as each has his own desk where he can sit down (see picture below).

Furthermore, this waiting is not boring because it affords opportunities for discussion with colleagues (whether with the one working on the desktop or with the others in the same situation, finding themselves also waiting their turn) about the various problems encountered, or asking for help. In short, informal communication takes place during this short period of time. In other units, as in the St. Jean de Maurienne and Cluse sites, I saw this type of communication in the cafeteria when technicians have coffee together. In this way, mobile technology does not really remove this centralizing means of coordination for FT stationary workers. Moreover, I observed two different interactions: firstly between the ASS technicians and secondly with technicians from other services (seen next figure). However they are not represented by the same color because, as I will show, their purpose is not the same.

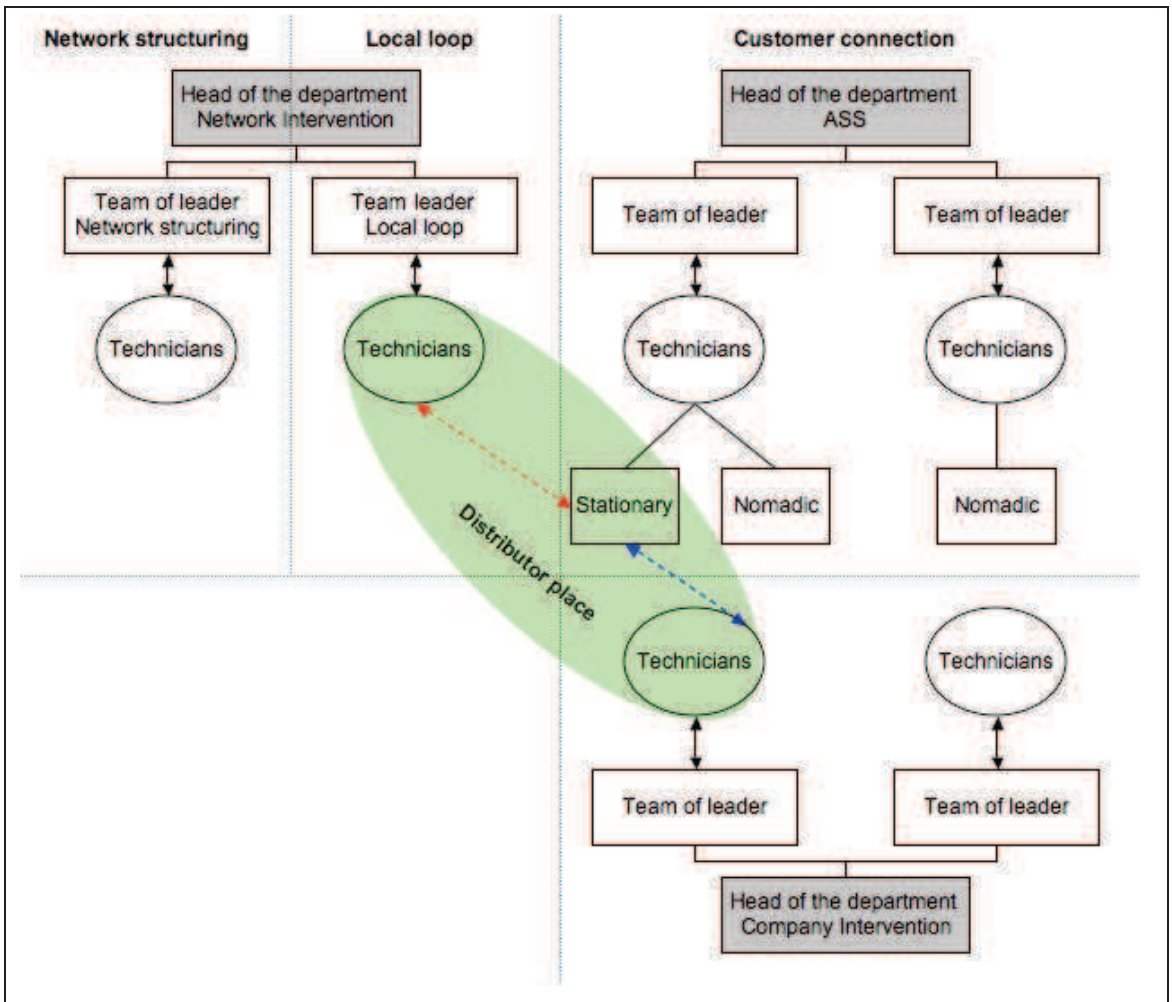


Figure 26. Simplified scheme of informal communication flow at the Albertville Site (source: Personal)

Based on my observations, I found that regular interactions between the ASS technicians occurred between the majority of people on the site. However, interaction with other technicians is uncommon. This result is explained by the fact that some departments like the LL were subcontracted (see next table). In what follows, I analyze the major benefits of both interactions to show the importance of informal communication for technicians, as well as to demonstrate to the FT management how they were mistaken in subcontracting the major part of their work.

Sites visited	**Interaction with technicians from similar departments**	**Interaction with technicians from different departments**
Isère		
Grenoble	**No interaction**	No interactions
La Mure	Many interactions	No interactions
Haute Savoie		
Albertville	Many interactions	**Many interactions**
St Jean de Maurienne	Many interactions	No interactions
Cluse	Many interactions	No interactions

Table 21. Summary of the types of interaction within the sites visited (Source: Personal)

1.1.2.1. Advantages arising from informal communication between ASS technicians

More than a just a simple access to the workstation in the morning, the distributor is the ideal place where informal communication can take place for between 15 to 30 minutes. Despite the short duration, the technicians exchange much useful information that could be of considerable use at different levels: individual, group and organizational. This includes benefits such as: increased global performance and personal technician productivity, higher quality of intervention on the network, customer satisfaction and team motivation.

Direct access to information is related to easy access to additional information by asking colleagues about the way they have dealt with one or other problem or the route that they took to get to some place, etc. This information is essential for individual productivity of the technician because he can save a lot of time by knowing how to solve a specific problem or the best road to take when it's snowing, etc. These situations are what I choose to call normal work access. However, this access becomes more crucial when an emergency arises. In this case, high reactivity is required from the technician. This reactivity is only achieved by accessibility to other colleagues' information exchanged in the morning (see Box 10).

Box 10. A story of how the relationship between colleagues increases reactivity

One morning when I was waiting for the technician to finish the preparation of his journey, I observed that there was one technician, in the room who was very pleased to learn from his customer (that he had on the phone to find more details of the address and the problem) that the problem had been solved and that his intervention was unnecessary.

After a while, I noticed a technician on the other side of the room expressing a different state of mind on consulting the nature of his intervention. He had discovered that he needed a cherry-picker truck that the dispatcher had overlooked. In order to reschedule the truck the technician notified his dispatcher, only to find that there were no drivers available for the time being. This news made him even more worried as he was sure he would not be able to fix the problem alone.

Having in mind the availability of his colleague, he asked him if he could drive the truck that was available at that time in the parking lot in order get the customer's problem repaired on time. The other technician understood the difficulty of the situation and accepted to drive the truck. A little later and before their departure, the manager came and thanked them both for their reactivity.

Shared autonomy is the fact that the technicians control their own work without any intervention from the managers. More precisely, I observed two control mechanisms involuntarily applied by technicians in their everyday interactions:

Controlling the unfinished intervention

France Télécom saw in mobile technology a new way to control and manage its technicians' productivity, because the team leader could now access information that was never possible before. However, the majority of the technicians don't comply to or are not convinced of this "management by number", as it was called by one technician, explaining his manager's job to me as being only concerned with the evolution of his performance graph.

This is also a source of conflict between the management and the technicians because the latter are not familiar with the logic of profit and number, being just concerned by customer satisfaction since people don't readily fit in with this type of managerial logic. By the story (Box 2) below I would like to show how social control**,** facilitated by a stationary mode of work, is more powerful and more efficient than number control**,** made possible by mobile technology and the nomadic mode of work (see Box 2 below).

Box 11. Examples of the power of social control

When a technician, on consulting the planned intervention in the morning, finds that it was initiated by a colleague and not by a customer, the first reflex is to directly ask the technician concerned about the problem, "*What has been done, what else is required, what is the location of the installation?"* At the same time, when he's asked, the technician is reassured because he knows that there is someone who cares about his customer and he knows how to ask this person later about the evolution of this situation. It is true that these questions help the technician's efficiency and save a lot of time but, in reality he is sending a message to the technician concerned: "*If I come in on an intervention after you I hope that this reorientation is really necessary*". In general the technicians don't like intervening after another technician it's because this means that the work was not well done the first time. So, to keep their reputation safe within their working community, the technicians do their best to complete the intervention successfully. They sometimes take risks during the intervention to ensure this (see next picture).

However this control has the opposite effect when, for example, the technician

designated is not available or on vacation. It is up to the technician at the origin of the re-orientation to launch the control process on arrival. In fact, I saw one talking with another technician about an intervention that he made. When I asked him to explain this situation, he told me that he had kept back the file of the customer in question in order to follow it up later and see whether the other technicians had solved this problematic case or not.

Controlling the completed intervention

France Télécom Management also sees in mobile technology, not only a new way to control its technicians, but also a new way to control the subcontractors' technicians because the latter can be connected directly to Information Systems of France Telecom via their mobile devices and get instant access to their workload. France Telecom benefits from this new opportunity in two ways. Firstly, by reducing personnel costs and fixed charges**,** because when someone has retired in a certain geographical area, France Telecom will not hire a new technician and responsibility for that area will be automatically transferred to subcontractors. Secondly, it increases the flexibility of the company, which can adjust the number of the technicians required according to the variability of the intervention requests. In fact, the number of requests can increase or decrease at different times of year. For example, when it snows many wires fall down and managers can anticipate increased needs and ask the subcontractors for more technicians. However, during calm periods the subcontractors will not be asked for their services.

However this flexibility is not without consequences because these newcomers are chiefly interested in increasing the number of interventions and thus charging France Telecom more. That's why, once they fix an intervention, the subcontractors' technicians run to the next intervention without doing any additional work, in order to save time.

In this way these technicians miss one of the major tasks of the FT technician, which is work done in addition to fixing a customer's problem, and that is the maintenance of the equipment or the site on which the intervention has taken place. In other words, the technician is supposed to leave the installation nice and clean before leaving in order to

improve their normal conditions of work. In this way, he makes the work easier for the next technician intervening on the same site.

However, when it is not cleaned up, I observed that the majority of the subcontracting technicians, once the problem has been dealt with, leave the site in a much worse condition than it was found before the intervention. The problem becomes serious if subsequent technicians do the same thing as this leads to the deterioration of the work conditions. This was explained to me by a technician using the "Theory of the Broken-Windows"[34] (see next figure). Under these conditions, the work become very hard for the technician because it decreases his motivation and increases intervention time because it is harder to identify the precise location of the problem.

Because of this behavior and because they are sharing a similar geographical area, the FT technicians act the same way out of a form of pride and thus no longer pay attention to the maintenance task and the work conditions. In this way, deterioration of work conditions becomes the rule rather than the exception.

[34] It is the first time that I heard about this theory and is defined by Wikipedia as "a social science theory which argues that small damage sustained in the public space necessarily gives rise to more general decay of the living and human situations associated with it".
http://fr.wikipedia.org/wiki/Th%C3%A9orie_de_la_vitre_bris%C3%A9e

That's why a stationary technician told me that: "*I will keep my geographical area even if I have a heavier mileage*". By being ready to make this kind of sacrifice (because in general the technicians don't at all appreciate doing long trips), they keep control over their geographical area, which is a fundamental issue for the way they work. In reality, the issue is not control of the geographical area in itself but rather control of the people working in that area. In fact, by keeping the subcontractors' technicians away from their geographical area, the technicians can easily exercise direct control over their colleagues without using any intermediary, just like their team leader. For example, when something goes wrong on the site, the technician will directly inform the FT technician concerned and let them know that he did extra work in order leave everything in order. In this way, he is sure that the technician concerned will never again leave the installation in that state. However, this process is not possible when a subcontractor intervenes in their geographical area and when something is wrong they must pass through their manager, in order to complain about that, who in turn should notify another service. In addition to being lengthy, it appears that the process of reporting problems stemming from subcontractor technicians is inefficient, and the technicians find it unsatisfactory.

1.1.2.2. 2. The management issue in France Télécom: managing by force

France Telecom has also seen the opportunity given by the use of mobile technology and, more precisely, the connection with their subcontractors, which is not only an opportunity to increase its flexibility but also a new way to increase its profits and this by changing its mode of operation. In fact, FT management sees its connection to subcontractors as a means of getting rid of all unprofitable interventions (such as all interventions in distribution) in order to focus on the profitable interventions like those involving direct contact with customers and in which all the costs of the intervention (traveling, new material) can be charged to customers.

This decision represents a big change for the technician communities because all the technicians known as "Lines technicians" must now be transformed into new "Multi-Services technicians" because their initial work is unprofitable and will be transferred to subcontractors.

In fact the technicians find themselves in a difficult situation because they must, not only learn an entirely new job late in life, but more importantly, also completely invert their values. This means going back on the original value of France Telecom, which was growth. In fact, FT technicians lived and worked with the idea of public service**,** which was central to company practice, and today they must incorporate a new and opposite culture driven by private profit.

This transformation was not easy for the FT management to undertake, due to the high resistance of many technicians, to the extent that some team leaders keep hunting them out and forcing them to comply with this change. One method is to take away the technician's FT car and downgrade him into a simple cherry-picker driver. The use of these compulsory measures partly explains the social problems that this company recently experienced. After a while, and particularly after the occurrence of the social problems at France Telecom, the management decided to stop pursuing the "line technicians", leaving them in peace until their retirement, even if this decision has a negative consequence because they will be excluded to a certain extent from the company and will feel unnecessary. The damage, in human terms, may be worse than any constraint.

The situation displays two aspects. Firstly, the management of change was a failure. Secondly, the use of force or exclusion to implement change leads nowhere except to great damage.

However, this failure could have been avoided if the management of change has been thought out differently and conducted in relation to a community rather than to separate individuals. This change would have required a more a stationary mode of work rather than a nomadic one in order to establish the right work dynamics (see Box 3 below).

Box 12. The importance of teamwork

One day when I was taking lunch with a technician and his team leader in Grenoble, the technician complained to his manager about the lack of commitment and interest of the cherry-picker driver in fixing the problem during the intervention he had carried out. Then, after lunch and during our walk to the manager's office, he asked him to find a solution to this serious problem. In order to pacify the technician, the manager said that he would look into, but in reality he knew very well that he could do nothing. There are many reasons why the manager is powerless[35] in dealing with this situation:

- This population of drivers has nothing to do with telecommunication because they were basically mechanics or coachbuilders until their services were scrapped or transferred to subcontractors. Thus, instead of dismissing them, FT transferred them to this service as drivers. All these circumstances oblige these drivers to conform but their unique motivation is to get out as soon as possible via retirement.
- Officially, this population is just responsible for taking care of the truck, driving it to the place where the technician will need it and finally looking after the security of the technician.

The driver stays on the ground while the technician works on the intervention

In fact the technician was right in complaining to his manager about this situation because the involvement of the driver during the intervention could save him a lot of time or even avoid missing a customer appointment. The problem that this technician was referring to, in order to convince his manager to make new decisions, is that during one intervention he made multiple round-trips between customer sites and the SR. He added that if this driver was committed and had the right material, he could send him to the SR and ask for the right **instructions** every time he carried out a new trial at the customer site. He argued that the intervention would be less tiring and a lot of time would be saved. On the other hand, the manager was also right in feeling that he was not concerned with this problem because from a managerial point of view, this driver was in order because he is complying with the roles prescribed to him. However, the real problem in this case is the lack of teamwork and the deterioration of the technician team due to this shift towards nomadic work. It is only the collective approach that will encourage this driver to do his best in order to belong to and be proud of his group. I explain the origin of this problem by this symptom, as it does not exist at all at the Albertville site where all the technicians were sedentary as in Grenoble. Their team also includes a cherry-picker driver, who comes from another distant department. However, and to my great surprise, this driver was totally involved in each intervention he undertook with a technician. Since he printed all the interventions, I observed his commitment by discussing each intervention with the appropriate technician.

The driver of the cherry-picker (on the right) making tests of the line while the technician (on the left) tries to fix the problem.

1.1.2.3. Advantages from informal communication with technicians from other departments

Based on my observations, two types of interaction were identified on the Albertville site: with LL technician and with network and company technician.

ASS technician - LL technician:

Today, at France Telecom it is publicly admitted that once an intervention is transferred to the LL business unit and to their related technicians, the GTR**, (**well-known criteria used by the ASS dispatchers) is immediately *"exploded"*[36] as the manager of LL-BB himself (Local Loop Business Unit) acknowledged, as recounted in Box 4.

Box 13. Difficulty in maintaining the GTR when a problem is transferred to the LL-BU

Manager LL-BU: The GTR (BU ASS) will do what they have to and then we will receive the file (of intervention) If we receive it, we'll have two problems. The first is that, in fact, we are not the first people intervening there. At the level of GTR we have no control, we do not have the time necessary, for example 48h. So, it will get here and then stay put for about ten hours. And afterwards, at the level of the Local Loop, interventions are not made over a…

Me: Short period

Manager BU LL: That's, it is not short term, it is not just two hours needed. Our interventions take us half a day, maybe a whole day. So we are dependent on the GTR but we can't today have a real indicator. We contribute to that but we can't fulfill it.

As is mentioned by this manager, the real issue of non-commitment regarding GTR performance is the small amount of time remaining to complete the intervention. This problem cannot be solved simply by good reactivity and personal involvement of the LL technicians. This reactivity, in turn comes into being only by informal communication between the LL and ASS technicians. However all these interactions have been removed because all the work in relation with LL interventions were subcontracted (see table above). From all these sites observed, it appears that only one maintained[37] the LL technicians in their function; its observation will allow me[38] to describe the level of informal communication, as well as the way it contributes to the reactivity of the LL technicians.

In what follows, and in order to describe these types of interaction, I divide them into two types. The main difference between them is the way this interaction is initiated, whether by the ASS technician or by the LL technician:

***LL technician → ASS technician*:** usually the interventions transit via the ASS technician before they get to the LL technician. The latter come to the office of the ASS technician in order to ask for details of the problem that the ASS technicians have encountered. This detail is not given in the intervention report and it is important for the work of the LL technician. In fact it informs the LL technician about the type of material required to fix the problem. In fact, any material used in the LL domain is voluminous and can't be transported by car. Wires take up a lot of room in the car so it is crucial to know the needs in advance.

Sometimes these exchanges are simply to let the others know what has been done for the customer during their intervention. In many cases, after changing the wires, these technicians call the customer in order to ensure that their line is fixed, which is not the case for subcontractor technicians because their task is limited to changing the wires and no more; they are not concerned with anything else.. After calling the customer, three cases appear:

- **If the customer is not reachable**: in this case the LL technician goes to the point of connection of the customer in order to test the line. If the result of the test is positive, no more action is required. However, on the contrary, they leave a

message to the customer informing him that he should call the 1013 in order to get an appointment with a technician.

- **If the customer's line is ok, no more action is required.**
- **If the customer's line still does not work**: two situations are possible:
  - *LL technicians can fix the problem*: This case is more interesting than the two others because it reveals a higher degree of involvement to ensure customer satisfaction. In fact, when the line still does not work, the LL technician goes the customer's place, tries to fix his problem and often succeeds. This can be explained by learning from one another. For example, one of the two technicians present on the Albertville site had learned the other's job. In fact, one does overtime every Saturday and because his service is closed on this day he works in a twosome with another ASS technician. In time, he learned the job to such a degree that he started working alone on Fridays (when they finished the work earlier than planned), on interventions requiring no appointment with the customer; he then called his Saturday partner in order to inform him. Obviously the ASS technician concerned has no reason for discontent.
  - *LL technicians cannot fix the problem*: if the technician, after a certain number of tries cannot fix the problem, two situations arise according to the location: whether close by or far away**.**
    - Asking the other colleagues for help: Through the brief morning discussion between the LL and the ASS technicians, each knows other's place which is important when, for example, the customer intervention technician in attempting to repair the problem of the customer finds the problem does not concern him but the LL technician. Knowing that the LL technician working at that time near to where he is, he can call the LL technician in order to know if he is still at the same place. If it is so, he will ask him to come and help him to get the customer repaired in time and from the first intervention. as they can tell the customer where to get the appointment**.**
    - If the original ASS technician is not available or if the LL technician already knows an ASS technician working in that place, they will inform the customer that they have to call 1013 again in order to get a new

appointment with the ASS technician. Finally when they come back to their office and meet the initial ASS technician who reoriented the problem to them, they will inform him of what has been done.

ASS technician - LL technician: this kind of interaction is rare but also important for two types of maintenance actions:

- *Preventive action*: One day I observed a technician going to his colleague's office to inform him about a fallen FT wire that he saw while traveling. When I asked the ASS technician why did he did so, he explained that this wire was near the LL technician's home so he could look at the problem on his way back from work.
- *Refusal of preventive action*: The above situation is not usual for the other site. Moreover, the technicians are less concerned when they encounter this kind of situation. In fact, when I was traveling with a technician in Grenoble and he saw a fallen wire; he said he had seen the wire like that every time he took a reading. He added that before, French people were more concerned and called the 1013 in order to report this kind of problem. However, once the company had been privatized, people did not care any more He said that it was the case for him, and he would wait until customers affected by the problem called in to report it.
- *Corrective action*[39]: During the intervention, and if the ASS technician figures out that the problem requires an LL intervention and remembers from the morning conversation with LL technician working nearby, he will call the LL technician in order to ask him if he is available to come with the required material to fix the problem immediately.

ASS technician - network or company technician: unlike their interaction with the LL technicians, the interaction between ASS technician and network or company technician is rare or less work-related:

- *Rare chance interactions*: These are rare because their respective offices are located within two different buildings. But because these two actors share the same parking lot, they occasionally cross one another on their way in or out.
- *Less work-related interactions*: when these technicians meet each other they don't talk about the content of their intervention but about the places where they should

make interventions. It appears that this simple interaction is useful later for individual productivity, because I have seen a technician from the Companies department coming to the ASS technician offices in order to ask him about the road to take in order get to the place they had been talking about, and where he needed to go that day.

1.2. Unexpected results

In short, whether stationary or nomadic, the coordination between technicians is undertaken only through informal communication. However these interactions are more frequent for the first category of technicians and rarer for the second one. That's why during my observation I was surprised by the fact that many nomadic technicians don't comply with actual divisions established by FT management and described above. In fact, I observed that many nomadic technicians become stationary (see next table). This observation is simple because when I come in the morning to the distributor and see that a technician has arrived there with a FT car I understand directly that he is not complying to the prescribed role.

Visited sites/ Days of observation	**Role transformation**
Isère	
Grenoble	Nomadic (having no choice)
La Mure	Nomadic → Stationary
Haute Savoie	
Albertville	Nomadic → Stationary
St Jean de Maurienne	Stationary Nomadic → Stationary
Cluse	Stationary Nomadic (having no choice) Nomadic → Stationary Nomadic (taking advantage from that mobility)

Table 22. Nomadic and stationary work in the visited sites

So, I asked one nomadic technician transformed into a stationary one for an explanation about this change. His response was "*It's a long story*". To be brief, this story is that at the beginning of the new phase of mobility, all the nomadic workers regretted the stationary mode because they missed all its advantages (some of them are described above in the paragraph related to this mode of work). That's why, at the beginning, they continued to work in a sedentary manner even if they were officially nomadic. This non-compliance with the organizational rules was not at all appreciated by the management of FT because all the benefit that could be gained from mobility was lost. That's why, one of the tasks of the team leader was to look out for them in the distributor until they complied with the rule and accepted their prescribed role. But, since the emergence of social problems, FT top management has decided to change their tactics by paying more attention to the social dimension. This reorientation has many implications for management practice; among others, the managers no longer pay attention to this aspect and must respect, within reason, this choice of changing the role from the nomadic to stationary.

It appears from this discussion that mobility and informal means of coordination are incompatible and technicians prefer the second at the expense of the first.
This is an understandable result due the advantages that technicians can get from the use of mutual adjustment. However, the choice becomes incomprehensible when during the day they also use the desktop within the distributor because many of them are equipped with a workstation (see the next pictures), instead of using their mobile devices. This unexpected result creates also a doubt about the usefulness of mobile technology in general. In another words, if a nomadic technician can become sedentary and if, during the day, he can use the desktop instead of the mobile devices, what is the use of mobile technology?

1.3. When mobility becomes an imperative and not just an alternative

Thus, it is clear that the organization of the technicians is very flexible as they have a choice of multiple technologies to accomplish their work. However, this description gives no indication of the great value of mobile technology which has been studied by (Kristoffersen & Ljungberg, 1998). One of the aims is that the technicians develop the notion of mobility and more precisely of the modalities (see next figure), of which there are two main types: local and remote (see next figure). The main difference between them depends on the place of work, inside or outside the building. FT technicians working outside are concerned only with the remote mobility, for which (Kristoffersen & Ljungberg, 1998) employees have two activities: visiting and traveling.

The first activity is defined as "*spending time in one place for a limited period before moving on to another place. For example, a consultant is visiting when spending time in a client organization, a researcher is visiting when giving classes in a schools for a couple of days*". The second is defined as the "*process of going from one place to another in a vehicle. For example, the customer is traveling when she goes by train from her home to the work place, the traveling salesman is traveling when he goes by car from on client organization to another, and the holiday makers are traveling when they go by plane to Hawaii. The traveling type of mobility seeks to capture the mobility of people that go in vehicles*".

Figure 27. Three kinds of mobile modalities (Kristoffersen & Ljungberg, 1998)

The development of these modalities of mobility allows Kristoffersen, (1998 #480} to identify the suitable devices for each category of mobility (see next table).

		Technology		
		Mobile	Portable	Desktop
Modality	Wandering	✔		
	Traveling	✔	✔	
	Visiting	✔	✔	✔

Table 23. Modalities and technologies (Kristoffersen & Ljungberg, 1998)

Through this modality-technology match, it's easy to understand why flexibility in the use of either mobile or stationery devices is allowed for FT technicians. It is because they are exercising the activity of visiting. However, this flexibility is no longer possible when an activity must be carried out during travel. According to Kristoffersen, (1998 #480}, during this period just two types of device can be used: the mobile or the portable. The first device is used when the traveler is at the same time the driver of the car while the second one the traveler is a passenger. In connection with our study, FT technicians are more concerned with the first case because they are at the same time the traveler and the driver of the car. In this instance, they use this mobile during their travel in order for example, to call the customer when unable to find where he lives, or maybe to call the dispatcher in order to make a reorientation of the previous intervention, or sometimes in order to communicate their work during their traveling when the device is put in front of him on the windshield.

Moreover, Kristoffersen, (1998 #480} adds that the modality-technology match occurring in an immediate environment, whether physical or social, will also impose a certain type of use. According to this author, the relationship between these elements can be represented in a model of what he calls the "*mobile IT use*" or "*mobile person's use of IT*" (see next figure).

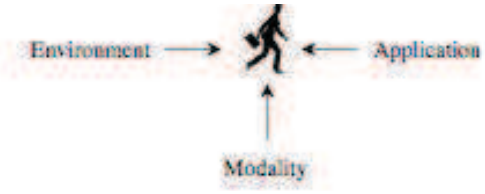


Figure 28. The model of IT use (Kristoffersen & Ljungberg, 1998)

However, according to (Lyytinen & Yoo, 2002), this model of mobile IT use is individual and does not involve any collective activity such as coordination. The FT technicians are not concerned at all with coordination because they carry out their activity individually, on the move, using mobile devices and faced with an external environment.

This result obliges us to look at the next consequence of the nomadic IS outlined in the introduction of this chapter: the transfer of "direct supervision" from the manager to dispatchers. To do so, we must move away from the department of Customer Intervention and enter a new department called Business Management. More precisely, we will examine one of its Business Units called Customer BU to which direct supervision is transferred.

2. Section 2 The impact of the Nomadic Information Systems on the Customer Business Unit

The Customer Business Unit to which the direct supervision is transferred employs 16 dispatchers who are in charge of managing (or "direct supervising") over 160 technicians: 120 FT technicians and 40 subcontractor technicians. However, before analyzing this Business Unit in relation with our problematic, we must consider the department in which this Business Unit is located and the entities with which this Business Unit may interact.

The BM department has 100 people and 6 support groups. Unlike the Intervention Departments, where each department covers a specific part of the network, the Business Management Department is designed in a such a way as to cover, via its four Business Units, the whole network. After Sales Support (ASS) and Production collectively cover specific customer connections (either underground or overhead), i.e. the link between the PC and the customer's home. The other support groups include Production and Local Loop Business Units (LLBU) and are located together with ASS because together they cover the whole ALP FT network (see next figure). The LLBU is responsible for all the cabling and wires that physically extend between distributors and the Point of Concentration (PC). This Local Loop is further divided into two networks: transport (between the distributor and the sub distributor) and distribution (between the sub-distributor and the concentration point). The LLBU is responsible for global infrastructure and not for specific client technical difficulties.

The first three Business Units are located in the same place called the "Platform". This physical proximity between these three business units allows dispatchers from different units to interact easily and to have instantaneous feedback about problems, thus increasing their efficiency.

In addition to these primary activities, The BU department also includes two transversal teams (Supply Quality Management (SQM) and C3P (Projection, Planning and Programming group)). The relationships between After Sales Support business unit and SQM and CP3 will be studied in the next paragraph.

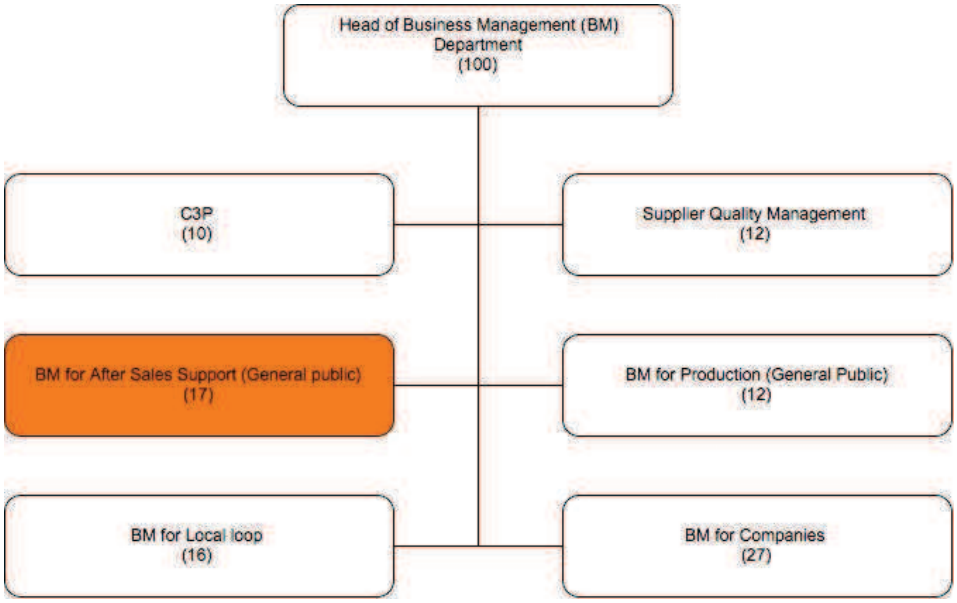


Figure 29. The flow chart (internal document)

2.1. The primary activities

2.1.1. Business Unit – Local Loop

There are 40 people in the Local Loop service unit. This BU is divided into two main activities: Production and After Sales Support.

- *Production*: For example, when a customer makes a request for a new phone line but his network area is saturated (meaning there isn't an available line) the problem is transferred to the "business development manager" of PEUFEL. The manager studies how to extend network capacity. After the study, the PEUFEL creates a work order called an SOP (small-scale infrastructure operations) and sends it to the Local Loop dispatchers via WLM (Work Load Management). The dispatchers are then in charge of delegating this order to technicians.
- *After Sales Support*: this activity implies a direct interaction with ASS dispatchers who transfer problems concerning the telecommunication infrastructure.

2.1.2. Business Unit – Production

The Production BU establishes new phone lines for customers. Creation of a new phone line means establishing all the necessary connections throughout the network from the distribution point to the point of concentration.

This Business Unit includes two groups of dispatchers:

- Seven dispatchers are in charge of organizing interventions requiring physical access to client locales. (Installation of a phone or Numeris line or lines for a temporary event, for example). These technicians perform roughly 250 interventions per day.
- Four dispatchers in charge of organizing interventions not requiring an appointment with the customer. The technicians in this sub-group perform around 1000 interventions per day.

These two kinds of dispatchers manage over 60 technicians in total, the majority of whom are subcontractors. However, in terms of workload, interventions are almost always done by appointment and for the most part scheduled one week in advance. As a result, there is less dispatcher-technician interaction than in the ASS business unit.

2.1.3. Business Unit - Company and Network

This BU supports more complex products for corporate clients. This business Unit has three main centers of activity. Network Structuring concerns network evolution. After Sales Support takes care of all XOIP products, like IP products, leased lines and routers. Finally there is PABX and private networks. These three activities require three kinds of technicians and thus three separate internal business units.

2.2. The support activities

The support activities are those that are generally dedicated to support others principal business units in direct contact with the FT technicians.

2.2.1. C3P- Projection, Planning and Programming group

This transversal unit positioned between the other business units is in charge of managing resources (i.e. technicians) needed to perform activities required to respond to the service requests.

Projection, Planning and Programming (the 3Ps) are the three core activities of this unit:

- *Projection* is management of daily and weekly resources (resources put in place to ensure a full, adequate response to customer requests). This group forecasts the resource needs one week in advance and then adapts and adjusts these forecasted resources to reality. The core activity of this business unit will be detailed later.

- *Planning* identifies the competence gaps in the field vs. the required competencies and plans training sessions for technicians to improve lacking competences.
- *Programming* develops software to assist the dispatchers in their work.

2.2.2. Supply Quality Management (SQM) Pole:

This is the interface between FT and its subcontractors. There are three major subcontractors that provide technicians to supplement FT employees in case of need: FORCLOM, CETELEN and CONSTRUCTEL. These subcontractors are divided into two categories. One is multi-technical infrastructure maintenance services, after sales service, production, jumpers, internet multi-services and lines. The other group of subcontractors work on services related to Optic Fiber technology.

The relationship with subcontractors is managed by different means:

- *Managing contractual aspects*: Each year or semester contracts are revised and renegotiated, on the basis of a national FT Orange document that is then locally amended.
- *Contract review*: Reviews are done monthly, two times out of three by phone and one time out of three physically. These meetings allow an overview of all subcontractor activities and their engagement in terms of finance, billing, stock management, waste management, and information exchange (news, action plans). They also provide a forum for discussing problems and problem resolution.
- *Briefings*: a weekly activity that consists of evaluating the previous week in terms of Quality of the Service.

This pole is in charge of four activities: billing (customer billing, external operators), quality of service (performance indicators), audit (auditing subcontractor field workers) and production management.

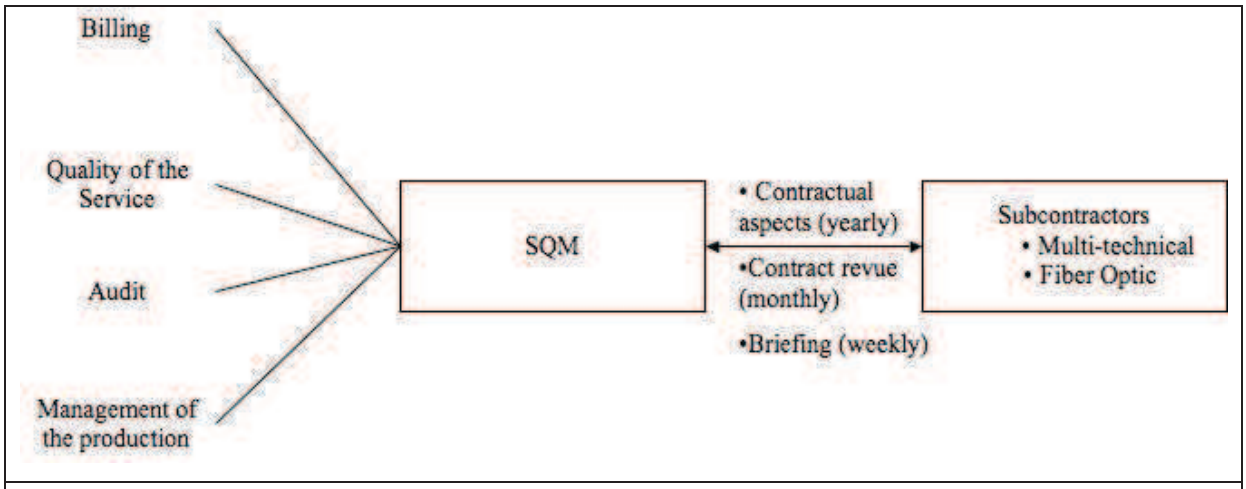


Figure 30. The relationship between the SWM and the subcontractors (Source: Personal)

2.3. Relationship between primary and secondary activities

Using the flowchart as a means for presentation of the organization doesn't allow us to understand the connection that exists between the entities, more precisely the primary and secondary activities. To do so we will describe in detail the interaction between the Business Units and the role that C3P plays in managing and providing resources to the After Sales Support Unit. Managing resources in C3P is done in two ways:

- *Anticipatory weekly resource management*: Advanced weekly forecasts of the required resources are prepared. They identify how many technicians will be required from the subcontractors for the coming week. This activity is generally called "**Supervision**".
- *Daily adaptive resource management* tailors forecasted resource needs to reality. If, for example, it appears that there are too many or too few technicians to handle the workload changes are made. This activity is generally called "**Optimization".**

Next, we'll describe in detail the entire operating flow.

***Step 1*:**

Resources request means that the supervisor makes a resources forecast for the coming week. They look at available FT resources and fill the gaps with subcontractor resources. The resource forecast is made based on several criteria:

- *FT's technicians*: Supervisors scan, area by area, all the available technicians for the next week. This information is available via the Workload Management tool (WLM) because technician managers enter technician presence into the WLM two

weeks in advance. Based on this information supervisors know the resources that are available in case of need.

- *Trending*: This criterion is used by the Production BU because all interventions are scheduled one week in advance to optimize use of the required resources.
- *Outstanding service requests*: All the service requests in the WLM are scanned area by area to identify those interventions that need to be performed.
- Subcontractor productivity: Depending upon sub-contactor productivity, the resource requests vary. For example, in the North Isère, CONSTRUCTEL's technicians complete 8 interventions per day while FORCLOM's technicians complete only 6 interventions per day. Managers will request fewer technicians from CONSTRUTEL than from FORCLOM because CONSTRUCTEL's technicians are more productive.
- *The weather*: Supervisors pay close attention to weather forecasts to fine tune their resource requests. For example, a forecast of snow for the following week implies that many aerial cables may fall and that many phones lines will thus be interrupted resulting in many services requests from customers.
- *Seasonality*: Resource requests vary depending upon the season. For example, in the beginning of the academic year, supervisors know that service requests will increase from students wishing to install Internet, phones, etc… During holiday periods, service requests may increase because vacationers activate suspended lines in vacation homes.

Based on these criteria the supervisors will determine the required resources needed in two weeks time by area and by technician competence. They will then send their requests to the SQM on the Monday morning of the week prior to the needed date.

***Step 2*:**

On Monday, the SQM collects all the resource requests from the supervisors and from other services and sends them to the sub contractors.

***Steps 3 and 4*:**

On Wednesday, the SQM and the supervisors receive via e-mail answers from their sub contractors (in the form of excel files which include the names of available technicians by area and by competence). There are two possible responses.

- Subcontractors respond positively to the initial request and will provide the needed resources in the form of the exact number of technicians (if this is the case, see step 6).
- Subcontractors respond negatively to the initial request for resources (in this case step 5 is required).

Step 5:

There are two cases when supervisors directly contact subcontractor personnel:

- To negotiate resources when they didn't receive a positive response to their resource request.

- They call during the week to modify an existing request by adding or decreasing requested resources.

Step 6:

In this step supervisors enter all subcontractor technician information into the WLM on Thursday.

All further steps concern daily adaptation of resources.

Step 7:

Dispatchers attempt to warn Optimizers in case of risk of technician under or overload.

Step 8:

Optimizers call the subcontractors' dispatchers to adapt the resources to the real situation. For example, in the case of an over or under load of resources they will reduce or increase the number of technicians on duty.

Step 9:

Implies a discussion of resources between the Optimizer and Supervisor. The Supervisor informs the Optimizer of the available technicians at W+1. Similarly, at D+1 the Optimizer informs the Supervisor if there are too few or if there are too many technicians to complete the outstanding service requests.

Step 10:

Optimizers and Recovery Managers report to the SQM in cases of poor subcontractor service quality or lack of reactivity, in the event of repeated lack of sufficient resources or if the subcontractor did not accomplish the required interventions.

Step 11:

The Jumper Manager informs the Supervisor of their required resources at W+1.

Step 12:

If the Dispatchers are low on activity for their own technicians, they can offer technician support to the Jumper Service Unit.

2.3.1.1. Conclusion of chapter 4

Throughout this section, I tried to analyze the two major impacts outlined in the introduction of the FFA in France Télécom. In relation to the first consequence, I found that the Nomadic IS is an enemy to coordination because its use takes the technician away from much coordination activity and puts him on an individual, more isolated level of activity.

On the other hand, and in connection with the second proposition, claiming changes toward more informal organization, I find, a new unusual relationship that connects this Business Unit to an entity called C3P. This closeness is useful in facilitating informal interaction, initially introduced by the use of the Nomadic IS. This makes the organization very complex because there are overlapping connections (see Box 14 and next figure).

Box 14. Layer over Layer

Such is coordination. This is where we enter into the notion of coordination and the multiple entities involved. This produces a concept of coordination with multiple difficulties resulting in an organization with several layers, whose objectives are often conflicting, and sometimes, completely opposed. So the problem is: "*Who does what*?" which brings us back to the concept of management; if it's not controlled upstream, what priority? What framework? What procedures? It is confused and confusing and going round in small circles. The shortsighted view of the situation means shifting responsibilities from one to another, with each supervising element overlapping and interfering with the next. The lack of overview and subsequent disorganization defeats the aim of coordination, which is efficiency.

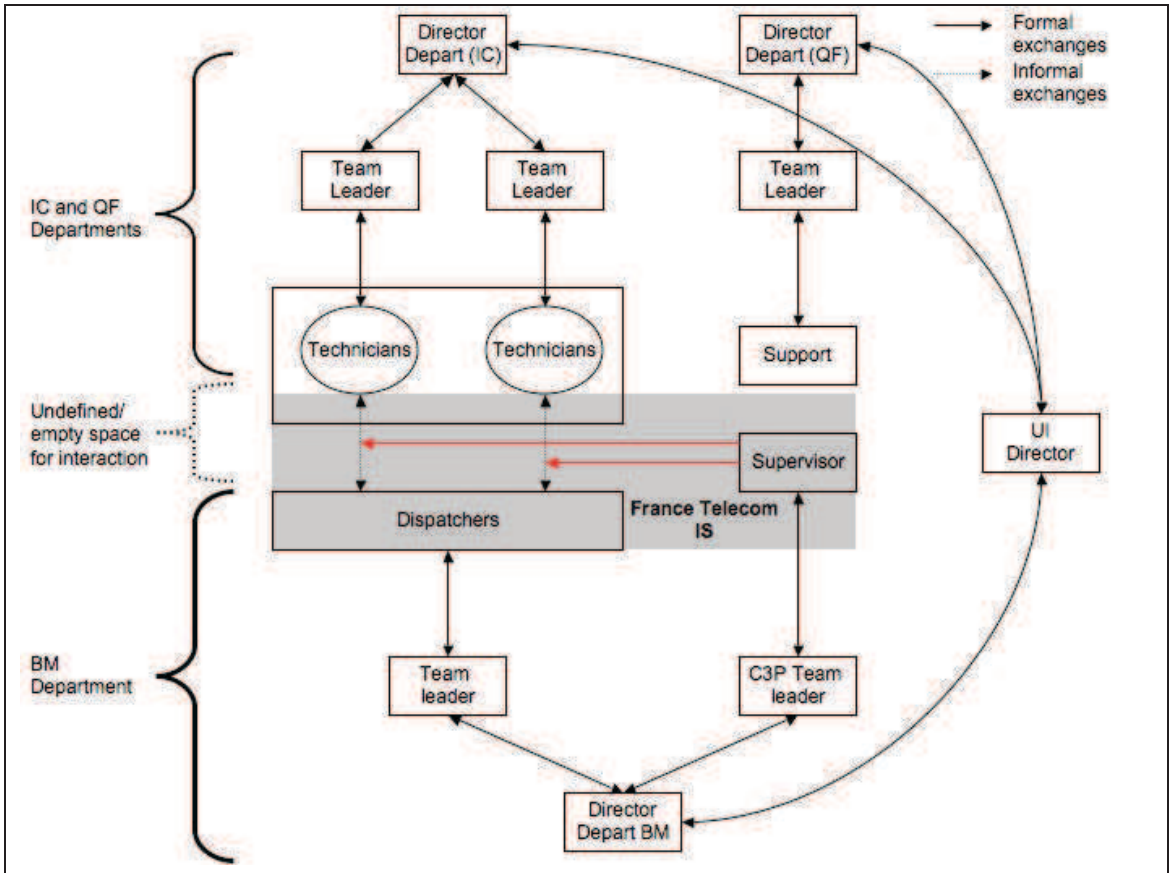


Figure 31. Mixed organization triggered by mobility (Personal[40])

Linking two different layers so as to form just one organization is uncommon in organizational theory, which usually separates the two. It is also uncommon for FT managers (in charge of the design of this processes), who call this new organization a "*mixed structure*" (see Box 15).

Box 15. Nomadic IS, mixed structure and organizational processes

"If one starts from organizational structure, it may be either a hierarchy or a matrix. However, this structure is mixed today, in the case of FT, except that we have adapted the process neither to its specificity nor to its type of management. We are still trying to find the solution. We thus sometimes meet contradictory views because there are entities that have different objectives and processes that are ill-defined and evolving in an uncontrolled way. We have difficulty in adapting the processes to the organization and then to inform people about those processes. Mobility, if I come back to the initial problem, is the heart of the matter; it was set up without respecting the previous functioning nor matching it with existent organization. Do you follow me?"

Following the content of Box 15, it is to be noted that only the nomadic IS engenders this kind of mixture and in that way makes their design impossible. These "*designing processes resulting from this mixed structure and supported by the Nomadic IS*" are studied in the next chapter, (after identifying the nature of this Nomadic IS in Section 2) in order to justify its location within the France Telecom IS, which is the objective of the next section.

GENERAL CONCLUSION

1. Summary of this Research

1.1. Problematic

Our research study has been derived from major theoretical examination and practical, *in situ* observation of the use of a category of mobile technologies called Wireless Field Force Automation, which has proved to be very beneficial for companies and other organizations by increasing technicians' individual and organizational performance. In fact, by the use of these new technologies the technicians no longer have to go to the central station in order to get their workload, but can receive it directly on their smart phone and start working from home. In this way, by saving travel time, the organization increases its technicians' productivity because they can thus carry out more interventions in their working day and, moreover, overheads are reduced by the lower gas expenditure. The economic advantage is obvious and huge when this technique is applied on a large scale, especially for companies employing thousands of field workers.

It appears that the benefits for organizations are considerable, which is why the popularity of this technology has increased particularly for big organizations employing thousands of technicians. However, its use within an organization may lead to many troubles by profoundly changing existing modes of coordination. This is because what the technological designers have missed in this kind of change is that the technicians do not only get their workload in the central station, but also go to share experience, maintain community bonds, coordinate their work and resolve difficult problems. This shift in the coordination structure destroys the feeling of community and resulting teamwork, which is the basis of efficient management. This is the scope of the present thesis, which is more specifically related to examining in detail how this explosion of the community came about and how it has had a negative impact on organization and subsequent performance. It then explores a new type of change that has led to an organizational renewal with positive performance consequences.

1.2. Theoretical Framework

In order to explore this problematic we first examine analyses of types of change in organization, according to two classical theories, known as technological imperatives and organizational imperatives. Each favors one particular dimension at the expense of the other as a trigger for organizational change. For example, the theory of technological imperatives favors technology at the expense of organization, according to the supposition that only increasingly complex technology can improve and change organizational structure and subsequent means of coordination. However, the organizational imperatives theory advances the diametrically opposite argument, that in a system open to uncertainty, only the human, social factor can trigger organizational modification, in order to adapt to environmental contingencies.

After analysis of both research trends, it would first appear that our problematic, namely the change in technological organization, is more in connection with the first trend than the second socially orientated option.

However, after a closer look at the situation under consideration, in which technology is seen to have an impact on human organization, being detrimental to both harmony and efficiency, the convergent socio-technological viewpoint, including both sociological and technological dimensions, would seem the appropriate theoretical framework, rather than the two others, to analyze and understand the dilemmas and responses in the case under study.

1.3. Methodology

To deal with our problematic, I use Yin's case study methodology. More precisely, I apply a holistic cross-case design because it fits in well with our approach: comparison between two modes of organizational change within a single company. This factor is also the major criterion according to which the case under study has been selected.

In this thesis, France Télécom is the company selected because it meets our study requirements in two ways. Firstly, it has provided all its technicians, all over the country with the mobile technology, called E-tech (electronic technician), in order to avoid unproductive travel to and from the distributor (called the central station in our statement of the general problem) and to install a new system whereby the technician goes directly from home to the customer location. These workers are called nomadic technicians. According to our theoretical framework, this type of change reflects

technological imperatives because these technicians no longer have to pass through the central station in order to take their workloads, and this as a direct result of technological innovation.

In addition, this organization has operated an involuntary socio-technical change, because there are some technicians living near the distributor who have kept their traditional habits in addition to being provided with mobile technology for use in the field. In fact, these sedentary technicians don't have the right to take the company car home at the end of their day of interventions, but must return it to the distributor parking lot where they picked it up in the morning. In this way the technicians keep their habit of meeting their colleagues for a coffee and a chat in the morning before going to their interventions.

Thus, France Télécom provides us with an interesting opportunity to compare these two types of change across their two respective populations of technicians: nomadic and sedentary workers. This comparison was first carried out by observing the different practices employed by these two categories of technician in their daily dealing with similar problems. These observations were undertaken during a three-month period by daily following both types of technician working in different departments in the Alps of South-East France: Isère, Savoie and Haute Savoie.

1.4. Results

The results of the analysis, a comparison of two populations of France Télécom, are given in descriptive form. This description seeks to confirm the two propositions supposed by the socio-technical theory and also reveals the types of interaction made impossible by nomadic work, as well as the specific type of performance that this change give birth to, in a real world.

Two major types of interaction were identified in this case: interaction with technicians from similar units and interaction with the technicians from different work units. These interactions allow the technicians to exercise some sort of indirect control over other colleagues that has led to the emergence of certain values: for example, they have to succeed their intervention the first time, because otherwise their failure is seen by the colleague who follows on to do the job, and they thus lose status with their peers.

This sort of control also pushes technicians to keep the network safe because if another technician sees something wrong done by his colleague, he will fix it and give him a bad work profile. In this way, these types of interaction increase the technicians' productivity and the quality of the network for France Télécom.

However, a negative result of the technical change that the technicians don't know each other; the nomadic workers pay attention neither to the success of the first intervention nor to the quality of the network. In this way, technical change decreases organizational performance, through decreasing both the productivity of the technician and the quality of the entire network.

2. Contributions of the Research

2.1. Theoretical Contribution

This thesis proposes two major theoretical contributions. The first one is more in relation with exploring a new emerging technology called wireless FFA that has now a growing importance in service organizations. However, and despite this practical importance, little research on mobile business applications has so far been developed (Barnes et al., 2006; Scornavacca, Barnes, & Huff, 2006). In this sense, our thesis has the objective of bridging this gap by presenting a specific case of mobile business application and studying the changes that its use implies for organizational performance.

The second major contribution of this work is related to the effects of this change. Our study proposes a new type of change called the socio-technical change that leads to improved organization. In this way we develop the emergent perspective of change (Markus & Robey, 1988), necessary to avoid the determinism that dominates present-day thought about organizational change; we have been able to study, in a real-life context, the benefits of this mode of work transition in comparison with the more deterministic ones.

2.2. Methodological Contribution

The approach used here for undertaking this research is a confirmative qualitative research. This logic implies first, the development of opposing propositions derived from different theories, and formulated on the basis of the socio-technical theory, and

their description with examples drawn from real cases. This qualitative approach is used in order to confirm their validity in comparison with the initial propositions,

The confirmative approach is common for quantitative research that seeks a quantitative confirmation of the hypothesis stated at the beginning of the study,, through the use of statistical tools, The results of this type of research then demonstrate whether the results confirm the initial hypothesis or not.

On the other hand, and in order to be distinguished from the logic of confirmation usually applied in the quantitative approach, the use of qualitative research is frequently used, not to confirm a hypothesis, but to explore new phenomena derived from field studies by using the interpretive approach.

It would seem that there are two clearly distinguished methods, each with their own logic confirmative and interpretative; our major methodological contribution comes from seeking to overcome this opposition in the same research topic.

2.3. Practical Contribution

In order to show the practical contributions to this thesis, I will try to answer one manager's questions regarding the problem of mobility in France Télécom:

- **Practical Problem 1**

The exponential use of mobile technology in all walks of life is another huge Industrial revolution which has created new environments as well as modified personal and working relationships. Former patterns of functioning have been upset and adaptation has lacked the experience and foresight needed to protect what is essential: people, especially at work where they are subjected to other people's choices.

This study proposes an angle of approach for the management of France Télécom, in order to create a better social environment for the technicians whose difficulties have been overlooked owing to the uncharted use of recent mobile technology in organizations of all sorts. There is an urgent need to put people before and with technology, rather than the contrary. The transition can now be more satisfactorily implemented.

Box 16. Problem 1: The Transition

C3P Manager: …Concerning this study, I think it's necessary to start from concrete cases but it's also necessary to use a little more abstraction when what's true in our organization is not always true elsewhere, but you always find the same things when you examine human relations and management. You know the situation in France Télécom; we underwent a complete turnabout in terms of policy. Policy number one was the workforce, then the activity and finally the people. People were considered to be the adjustment variable. Do you know what that means?

Me: Yes

C3P Manager: So, you've seen certain number of things. And then they say: "*Do it the other way round, people first*". Great! but then it is necessary to see at which level. This is the crux of the matter. So, this means that you have to change everything, or do the same and in fact, we just change a bit. You must realize that overnight, France Télécom cannot say "*We'll not take care of the shareholders*," it doesn't make sense. Then, you have to say, what about social wellbeing**,** and then there are the media. So it must figure in your study; these elements should be revealed. You must see things from another viewpoint.

- **Practical problem 2**

The second contribution of this thesis is to provide evidence and convince the managers of France Télécom, through the use of concrete cases, how their technical innovations had a negative impact, not only on the well-being of their employees but also on the performance of the overall organization. In this way, we propose that these managers allow the diffusion of the socio-technical changes revealed in this study, to the entire organization. The cases of socio-technical change I was lucky enough to observe were very rare because there are some technicians that still resist the initial technical change involved in the implementation of FFA and the shift toward a socio-technical change.

Box 17. Problem 2: The problems related to transition

What is our community? So this is also another side of things, and whatever we gain, it always comes back to this. The objective in terms of management are performance indicators, so, okay we've won on performance, But what we've lost are skills, and inter-competence exchanges What we've lost are relationships and the sense of belonging. I belong to a group I am proud of, proud of what they do and proud to work with them. A We've lost all that, in any case it's risky So, obviously, mobility has taken all that away, hasn't it?

- **Practical problem 3**

Thus we can indicate to the managers how control could be accomplished remotely. More precisely, we justify how technical change can free the technicians from control. However, with well-designed socio-technical change, controlling employees remotely is possible and at low cost for the organization.

Box 18. Problem 3: How to control people remotely?

The manager: As people go on mobile, they don't see the person in charge, so when I meet the people in my team that I see every day, I know within 15 seconds whether they are feeling good or not. When you do not see people in the team, it is much more complicated

Me: That's true

The manager: So there is the aspect we must get back to, the human part and the notion of stress and inter-relational competence. Therefore, with the notion of mobility. We've got to change how we operate;

3. The Limits of this Thesis

This thesis has two important limits. First, studying socio-technical change also implies studying the new functions and roles that the managers should play in this organization. However, this thesis pays little attention to this type of change, other than stating its necessity.

The second limit is related to the quantification of performance because I have only revealed the type of performance impacted by this organizational change. My qualitative study needs a quantitative one to complete the enquiry.

4. Future Research

The present research opens up two future research trends. To further develop certain aspects which could not be treated within the scope of this study. Other new technologies deserve to be examined as this study is more concerned with just one type of technology called mobile computing according to the classification developed by (Lyytinen & Yoo, 2002), (see figure 32).

Furthermore, FT technicians with their mobile IT are not at all concerned with coordination and the collective aspect when they are outside in the field because they carry out their activity individually, on the move, using mobile devices and faced with an external environment. This situation reveals that the technicians are not really concerned with coordination when they are working in the field. This observation paves the way to explore other new technologies more concerned with coordination. That's why future research demands the examination of another, technology a type of nomadic computing called ubiquitous computing to weigh up its implications for coordination. Many questions related to this new technology need to be asked. What are the types of ubiquitous computing? How do they facilitate coordination and teamwork?, etc.

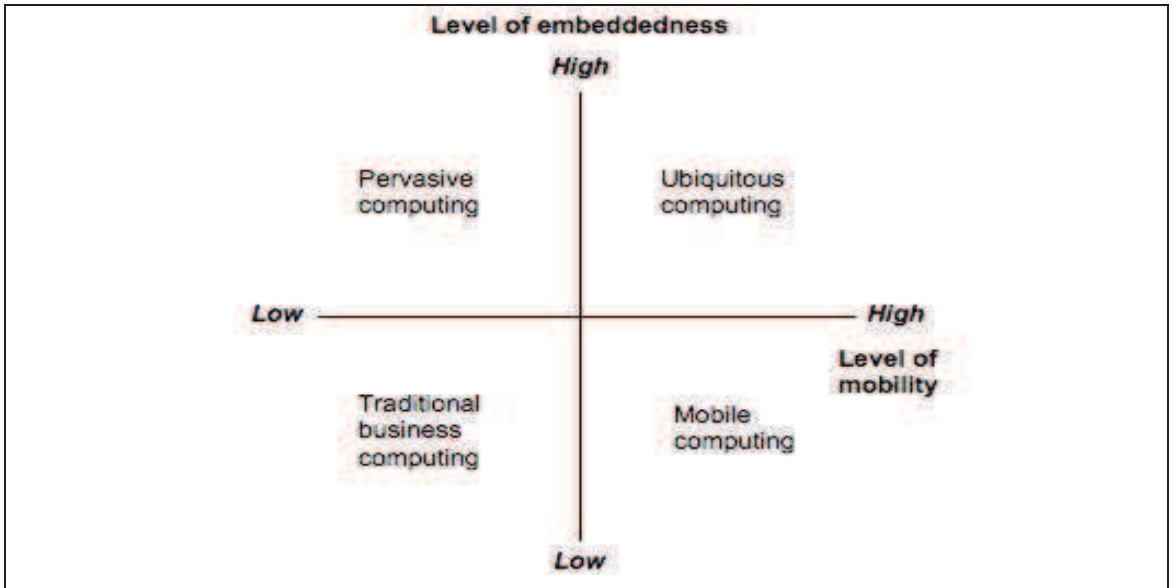


Figure 32. Dimensions of ubiquitous computing (Lyytinen & Yoo, 2002)

The second research perspective is that in this study we are more concerned with the question of the global impact of technology rather than its everyday use. In fact, this thesis is more concerned with a "*stimilus-response perspective*" which is concerned with "*fascination with new events"* (Boland & O'Leary, 1991). However, this fascination is not operative in the IS field and that's why we need (Boland & O'Leary, 1991) a shift toward technologies of inscription`, defined as "not a physical object`, but a form of practical knowledge. It is knowledge of how to do things that is shareable`, learnable`, and repeatable. A technology is a social invention that is malleable and shaped during use`, but whose use sets limits and opens possibilities that shape its users as well. It is the interdependencies among these technologies`, especially as they establish the conditions of possibility for the kinds of person and words that we experience`, that give rise to the emerging agendas of research". In addition`, (Yoo, 2010) shares this point of view with Boland and argues that the deterministic perspective obscures the approach to technology in everyday use and the ways technology mediates everyday work practices. When these aspects are taken into consideration (Yoo, 2010) advances the term of "*experiential computing*" and calls for new research on this subject.

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TABLE OF ANNEXES

Annex 1. Example of a teaching case study in relation with the use of FFA in organizations (Evans, 2002)

Company

ADC Telecommunications

Name: ADC Telecommunications

Web Site: http://www.adc.com

Symbol: ADCT (NASDAQ)

Business: Network Equipment

HQ: Minnetonka, MN

Employees: 19,000 worldwide

Revenues: Annual sales of more than $3.3 billion

Solution

Category: CRM and FFA

Application: Wireless access to order status information

>> Order Status
>> Shipping Dates
>> Tracking Numbers

Technology: Air2Web hosted service

Target Audience: Customers and Employees

>> 1,100 installers
>> 130 call center agents
>> 900 account managers

Devices:

>> 2000 Palm Pilots for Employees
>> WAP, SMS, and Palm VII for Customers

Challenge and Business Drivers

Business Drivers

>> Cost Savings

>> Competitive Advantage

Former Process

>> Installers used notebook computers and phone jacks to look up order status information

Benefits

Time Savings

>> Installers—5 hours per week

>> Call Center Agents—5 hours per week

>> Account Managers—2 hours per week

>> Total of 450,000 man-hours per year for 2,100 employees

ROI

>> Less than 1 month

Challenge

ADC Telecommunications wanted to leverage wireless Internet technologies in order to generate cost savings and also to maintain competitive advantage. According to Theresa Enebo, Manager of Client Systems and Services, ADC started the

project as a way to get their feet wet with wireless technologies and to gain some early experience and competitive advantage.

They focused on a single application for their initial wireless deployment: order status for customers and employees. Although the initial focus was on the customers, the application became popular internally and ended up being both employee and customer focused. The current process for employees to access order status information was time consuming with installers using notebook computers and having to search for phone jacks while on the customer premise.

Solution

The solution ADC chose was the Air2Web hosted service. The implementation took approximately four months, which included requirements analysis, coding, and testing. The order status application was rolled out to over 2,100 employees, including installers, call center agents, and account managers. The initial audience for the rollout was a couple of dozen employees assigned to their two biggest customer accounts.

Palm Pilots were purchased for the employees, along with leverage of existing employee devices such as Palms and SMS-capable cell phones. The solution was also designed in order to support customer access via SMS, WAP, and the Palm VII. ADC found that two-thirds of their employees used their existing SMS-capable phones to access the application and the remaining one-third used Palm VII devices with access via Palm.Net.

SMS was a key access method because it was a lowest common denominator with many employees. Moreover customers already possessed the devices. Using their SMS phones, users were able to obtain order status information either on-demand or via notification. The on-demand mechanism works as follows: The user dials a pre-determined phone number, the system recognizes them via caller id, and after they hang up, it sends the information to them via SMS. For users who wanted to enter a custom order number, an IVR system provided similar functionality but allowed them to key in the order numbers.

Information accessible via the application included order status information, shipping dates, and tracking numbers. In the future, ADC plans to add further functionality such as product pricing information, product availability, and ADC contact information such as sales contacts and office locations. An additional feature is that ADC plans to link in the UPS wireless tracking functionality so that customers can obtain full order status information and tracking in a single session versus having to visit two separate sites over their wireless devices. UPS is also a customer of Air2Web.

For training purposes, ADC used Webex in order to demonstrate the application. While they implemented support processes for customers and employees using the application, they found that they had very limited call volume from these end users, which indicated that the application was a success from a usability standpoint. Interestingly, one of the first challenges they faced when planning the solution was to convince themselves that

the application would indeed be usable given the subset of order status information they were delivering when compared to the complex order status application they currently supported on their Web site. By remaining open-minded about the wireless version of the application and not focusing too heavily on the technical differences between Web and wireless implementations, they were able to deliver a wireless solution rapidly and experience very positive feedback from end users.

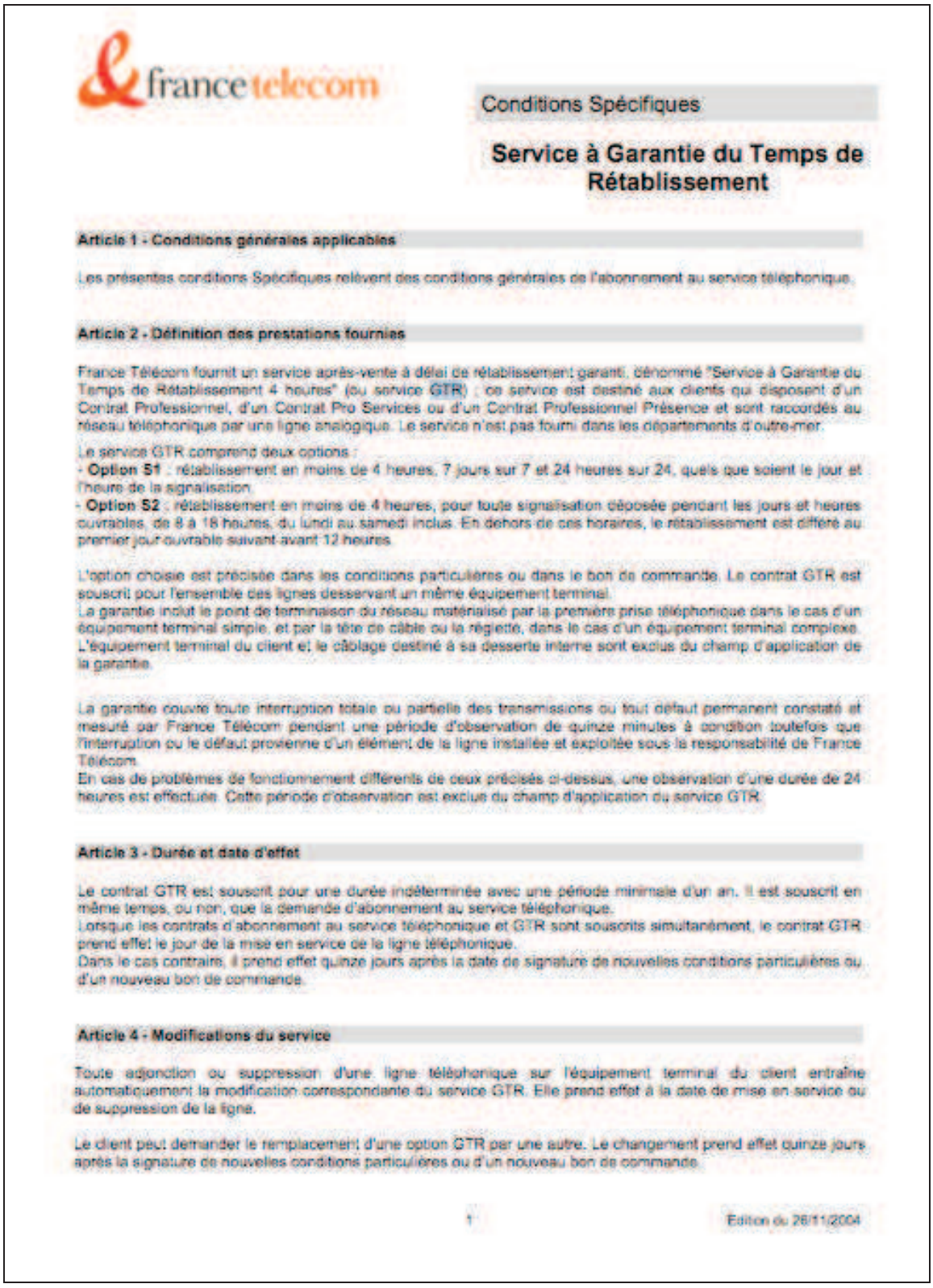
Benefits

The benefits of the deployment of the wireless order status application were considerable. The return on investment was generated in less than 1 month. 450,000 man-hours per year were projected to be saved when looking across the 2,100 person user-base. ADC estimated that between 2 and 5 hours per week were saved by using the application when compared to the prior order status process. These numbers were determined by interviewing end users and finding out how much time they were spending on order status determination. This involved both phone calls to customers and phone calls to each other—the calls were typically placed between the account manager and the customer service representatives.

The 450,000 man-hours per year figure was determined by taking the number of employees using the application and multiplying by the average figure for time savings based upon interviews.

By taking a simple application and transforming how it was delivered to both customers and employees, ADC was able to experience a substantial return on investment and increased customer satisfaction.

Annex 2. Guaranteed Time of Repair



& france telecom

Conditions Spécifiques

Service à Garantie du Temps de Rétablissement

Article 1 - Conditions générales applicables

Les présentes conditions Spécifiques relèvent des conditions générales de l'abonnement au service téléphonique.

Article 2 - Définition des prestations fournies

France Télécom fournit un service après-vente à délai de rétablissement garanti, dénommé "Service à Garantie du Temps de Rétablissement 4 heures" (ou service GTR) ; ce service est destiné aux clients qui disposent d'un Contrat Professionnel, d'un Contrat Pro Services ou d'un Contrat Professionnel Présence et sont raccordés au réseau téléphonique par une ligne analogique. Le service n'est pas fourni dans les départements d'outre-mer.

Le service GTR comprend deux options :
- **Option S1** : rétablissement en moins de 4 heures, 7 jours sur 7 et 24 heures sur 24, quels que soient le jour et l'heure de la signalisation.
- **Option S2** : rétablissement en moins de 4 heures, pour toute signalisation déposée pendant les jours et heures ouvrables, de 8 à 18 heures, du lundi au samedi inclus. En dehors de ces horaires, le rétablissement est différé au premier jour ouvrable suivant avant 12 heures.

L'option choisie est précisée dans les conditions particulières ou dans le bon de commande. Le contrat GTR est souscrit pour l'ensemble des lignes desservant un même équipement terminal.
La garantie inclut le point de terminaison du réseau matérialisé par la première prise téléphonique dans le cas d'un équipement terminal simple, et par la tête de câble ou la réglette, dans le cas d'un équipement terminal complexe.
L'équipement terminal du client et le câblage destiné à sa desserte interne sont exclus du champ d'application de la garantie.

La garantie couvre toute interruption totale ou partielle des transmissions ou tout défaut permanent constaté et mesuré par France Télécom pendant une période d'observation de quinze minutes à condition toutefois que l'interruption ou le défaut provienne d'un élément de la ligne installée et exploitée sous la responsabilité de France Télécom.
En cas de problèmes de fonctionnement différents de ceux précisés ci-dessus, une observation d'une durée de 24 heures est effectuée. Cette période d'observation est exclue du champ d'application du service GTR.

Article 3 - Durée et date d'effet

Le contrat GTR est souscrit pour une durée indéterminée avec une période minimale d'un an. Il est souscrit en même temps, ou non, que la demande d'abonnement au service téléphonique.
Lorsque les contrats d'abonnement au service téléphonique et GTR sont souscrits simultanément, le contrat GTR prend effet le jour de la mise en service de la ligne téléphonique.
Dans le cas contraire, il prend effet quinze jours après la date de signature de nouvelles conditions particulières ou d'un nouveau bon de commande.

Article 4 - Modifications du service

Toute adjonction ou suppression d'une ligne téléphonique sur l'équipement terminal du client entraîne automatiquement la modification correspondante du service GTR. Elle prend effet à la date de mise en service ou de suppression de la ligne.

Le client peut demander le remplacement d'une option GTR par une autre. Le changement prend effet quinze jours après la signature de nouvelles conditions particulières ou d'un nouveau bon de commande.

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Edition du 26/11/2004

Article 5 - Mise en œuvre du service

5.1 Signalisation des dérangements

Le client qui constate un mauvais fonctionnement doit respecter la procédure de signalisation suivante :
Après s'être assuré que le défaut ne se situe pas sur son équipement terminal, il dépose la signalisation, par téléphone, au centre de service après-vente de France Télécom dont les coordonnées lui ont été communiquées, en indiquant le numéro de la ligne concernée, la nature du défaut constaté, le numéro téléphonique de contact ainsi que le numéro éventuel de télécopie.
Le centre de service après-vente enregistre toutes les signalisations et les interventions relatives aux lignes qui bénéficient d'un contrat GTR.
Le délai de garantie court à partir de l'enregistrement par le centre de service après-vente de la signalisation de dérangement.
En cas d'impossibilité pour le client de permettre à France Télécom l'accès immédiat de ses locaux, le délai de garantie n'est comptabilisé qu'à partir du moment où cet accès a été rendu possible et France Télécom informée de cette possibilité d'accès.

5.2 Intervention de France Télécom

Lorsque le dérangement est localisé sur les lignes ou sur les équipements constituant le point de terminaison, la garantie GTR s'applique.
Les autres dérangements sont exclus du champ de la garantie. Dans ce cas, France Télécom informe immédiatement le client par tout moyen à sa disposition (téléphone, télex ou télécopie..) et lui fait part de ses constatations en lui précisant que le rétablissement du dérangement n'est pas couvert par la garantie GTR.
Si France Télécom est mise dans l'impossibilité de respecter le délai de rétablissement contractuel, elle en informe aussitôt le client par tout moyen. Le délai probable de rétablissement du service est précisé au client.

5.3 Difficultés de localisation du dérangement

Lorsque le dérangement n'a pu être localisé avec exactitude, France Télécom adresse au client un message téléphonique ou écrit lui indiquant que la présence de l'installateur responsable de l'entretien de son équipement terminal est nécessaire.
Si l'installateur n'est pas présent sur place dans les deux heures qui suivent le message adressé au client, le délai de garantie cesse de courir à l'heure d'envoi du message.
Le client et France Télécom déterminent d'un commun accord un nouveau point de départ du délai de garantie tenant compte du retard de l'installateur pour intervenir.
La présence simultanée de l'installateur et de France Télécom doit permettre de déterminer si le dérangement est localisé ou non sur les lignes ou équipements inclus dans le champ de la garantie.
Lorsque le dérangement est couvert par la garantie, le délai de rétablissement est calculé en cumulant la période écoulée entre la signalisation du client et l'envoi du message au client et la période écoulée entre la présence simultanée de l'installateur et de France Télécom chez le client et le rétablissement du service par France Télécom.

5.4 Compte rendu d'intervention

Dès que le service est rétabli, France Télécom notifie au client, par lettre ou télécopie, le compte-rendu d'intervention qui précise les éléments déterminants suivants :
- heure et jour de l'enregistrement de la signalisation,
- localisation du dérangement,
- nature du dérangement,
- heure et jour de rétablissement du service.

En cas de désaccord, le client renvoie annoté et signé, au service de France Télécom qui le lui a fait parvenir, le document "compte-rendu d'intervention".

Article 6 - Obligations du client

Dès la signalisation du dérangement, le client doit permettre à France Télécom l'accès du local où est situé le point de terminaison, 24 heures sur 24 et 7 jours sur 7. L'intervention d'un agent de France Télécom dans le local du client ne peut être effectuée qu'en sa présence ou celle de son représentant.
Le non-respect de ces obligations met fin à tout engagement de France Télécom dans le cadre du contrat GTR.

Article 7 - Pénalités de retard à la charge de France Télécom

En cas de non-respect par France Télécom du délai de rétablissement, si le retard n'excède pas deux heures, le client a droit, sans autre formalité, à une pénalité forfaitaire de retard égale au montant mensuel de l'abonnement au service téléphonique interrompu et à un mois d'abonnement au service GTR ; la pénalité est doublée si le retard dépasse deux heures.
Les pénalités ne sont pas dues si l'interruption résulte d'un cas de force majeure ou d'un fait imputable au client ou à des tiers.
Dans le cas d'un groupement technique de lignes, les pénalités s'appliquent à chaque ligne en dérangement au sein du groupement.

Au cours d'une année calendaire, le montant des pénalités accordées au titre de la Garantie du Temps de Rétablissement est plafonné à l'équivalent de 12 mois d'abonnement au service téléphonique et à 12 mois d'abonnement au service GTR.

Le montant des pénalités de retard est déduit des sommes dues par le client au titre du service téléphonique.

De convention expresse, ces pénalités constituent pour le client une indemnité forfaitaire couvrant la totalité du préjudice subi et excluent toute réclamation en dommages et intérêts pour quelque motif que ce soit.

Article 8 - Résiliation

La demande de résiliation du contrat GTR doit être déposée au moins quinze jours avant la date souhaitée de fin du service.
La résiliation du contrat GTR avant l'expiration de la période minimale définie à l'article 3 ci-dessus (y compris avant la mise en service des lignes) donne lieu à la facturation par France Télécom, à titre de pénalité, de la totalité des montants d'abonnement restant dus au titre de la période minimale.
Toutefois, aucune pénalité n'est due par le client si la résiliation du présent contrat avant la fin de la période minimale est la conséquence de la résiliation par le client de son contrat d'abonnement au service téléphonique après l'expiration de sa durée minimale.

Annex 3. The Units of Intervention at the UI ALPES

Annex 4. The research protocol

Protocole de recherche

COMMENT LES ACTEURS SE COORDONNENT-ILS POUR ETRE PERFORMANTS ?

Projet réalisé à l'Université de Grenoble, France:

Khoubeib Djemai

Doctorant en Systèmes d'Information au CERAG
Addresse: 150, rue de la Chimie, 38040
GRENOBLE cedex 9 FRANCE
Téléphone: + 33650158673

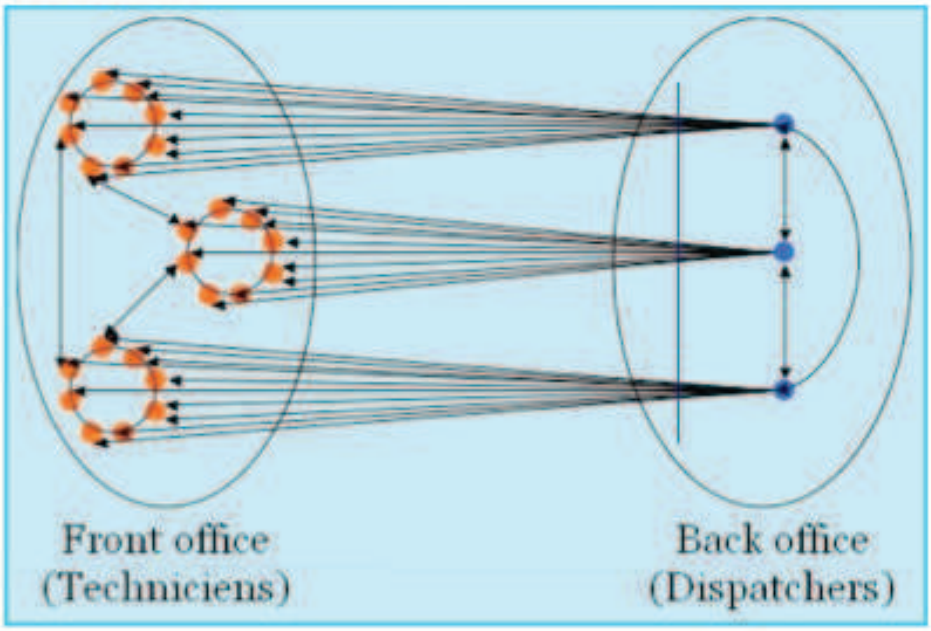
Plan de ce document :

1. Objectif général de la recherche
2. Contenu de cette recherche
3. Guide d'entretien

I. Objectif général du projet

Dans les sociétés de service[1], les liens entre les acteurs sont complexes et se manifestent à plusieurs niveaux (voir figure 1)

- Entre les acteurs du Back office
- Entre les acteurs du Front Office
- Entre les deux



Front office (Techniciens) — Back office (Dispatchers)

Figure 1 Les flux d'information dans le service support-client

Notre objectif de recherche est de :

Proposer aux entreprises de services des moyens d'optimiser leurs modes de coordination dont dépendent leurs performances.

Notre démarche :

Déterminer la manière dont les acteurs de ces organisations se coordonnent pour atteindre leurs objectifs, et ce, au travers de l'analyse de liens et d' interactions complexes nécessaires à leur performance.

[1] Le service se compose d'une partie visible (le « *front-office* ») qui comprend les supports physiques et le personnel qui est en contact avec le client et d'une partie invisible (le « *front-office* »). Il s'agit de l'organisation interne de l'entreprise de service.

Cette complexité varie selon les degrés de prévisibilité et/ou d'imprévisibilité des situations de travail (routines, incidents,…) rencontrées par les acteurs.

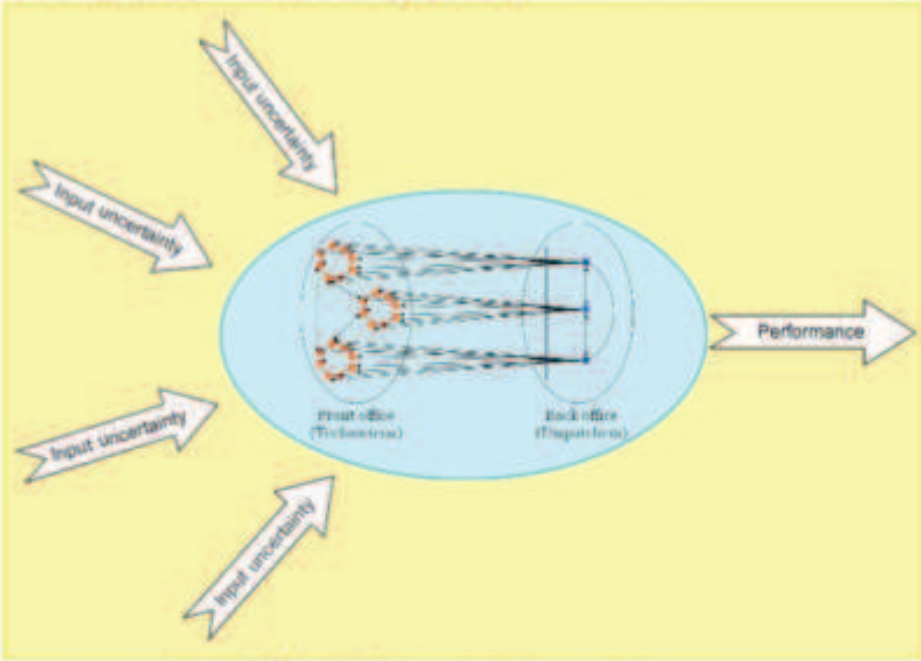


Figure 2 Adaptation face aux situations et aux circonstances

II. Le contenu de cette étude

A partir d'un travail de recherche mené à Cleveland, nous avons identifié que ces différentes interactions (cités ci-dessus) pouvaient être regroupées autour de deux axes (voir le tableau suivant):

- Axe 1 : **coordination de la tâche** : Ce sont des mécanismes et des solutions de coordinations qui impactent directement la performance des acteurs à travers de l'optimisation des trajets, des interventions... Ce type de coordination est nommé coordination de la tâche (task coordination). Ces mécanismes incluent : la planification, la priorisation, l'assignation, la synchronisation… Ils varient selon la prévisibilité des situations auxquels se trouvent confrontés les acteurs (par exemple, dans une situation prévisible, la planification a priori est possible à l'inverse d'une situation d'imprévisibilité où l'acteur va développer des solutions innovantes, informelles, ponctuelles,…).

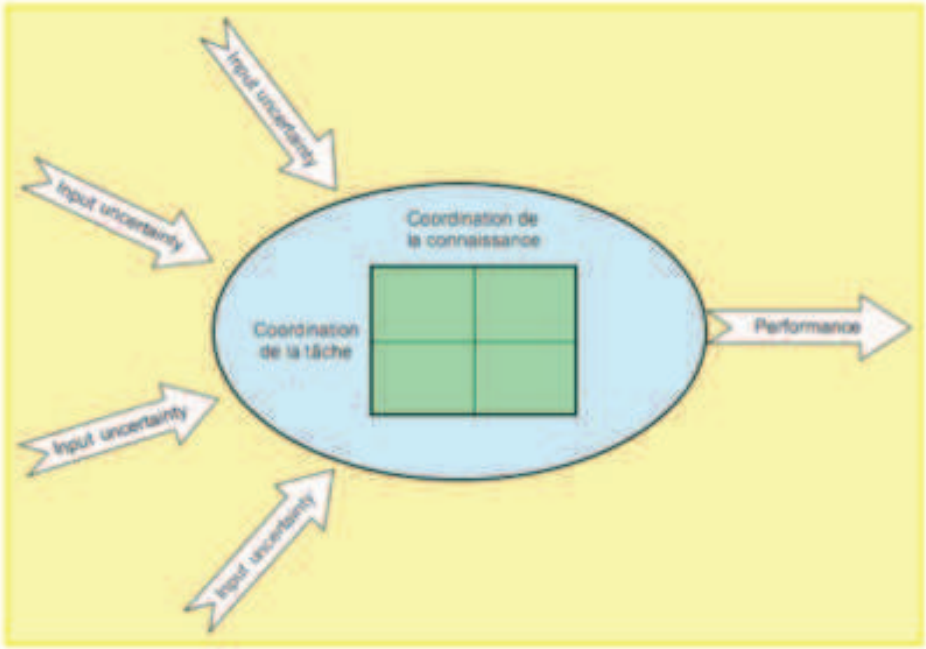
- Axe 2 : **coordination de la connaissance** : Ce sont des mécanismes invisibles qui impactent indirectement la performance des acteurs. Par exemple, quand un acteur rencontre un problème et n'arrive pas à le résoudre tout seul, il peut faire appel à une source extérieure pour l'aider. À travers ces interactions, les individus utilisent des connaissances et informations aux sourcing différents qui leur permettent de s'ajuster aux exigences de chacune des situations de travail. Ce type d'interaction est nommé coordination de la connaissance (knowledge coordination). Cette dernière repose essentiellement sur des réponses communicationnelles, relationnelles et interactionnelles entre les

acteurs (dialogues, conversations, échanges verbaux, non-verbaux, numériques,...). Ces réponses varient selon le type de problèmes. Elles peuvent être simples ou complexes (ces deux dimensions seront développées dans la section suivante).

Tableau 1 Modèle pour étudier les interactions entre les acteurs

		Coordination de la connaissance	
		Simple	Complexe
Coordination de la tâche	Prévisible	?	?
	Imprévisible	?	?

Nous intégrons le croisement de ces deux axes dans le modèle d'adaptation présenté plus haut.



L'objectif de notre étude auprès des conducteurs d'activité et des techniciens d'Orange est donc double :

- Comprendre les mécanismes permettant la coordination de leurs tâches dans les situations prévisibles et imprévisibles.

- Formaliser les manières de faire les plus optimales leur permettant la résolution de chaque situation.

Nos objets d'observation seront :

- *Les actions communicatives visibles*: dans ce cas, les acteurs s'adressent directement à leurs collègues ou à leurs supérieurs pour demander de l'aide. Ces actions sont explicites et visibles à l'œil nu. Il s'agit, par exemple, d'une demande d'aide (*Assign, transfer, refer, escalate*) auprès d'un collègue, du reporting d'un problème,...

- *Les actions communicatives invisibles*: dans ce cas, les acteurs utilisent des informations provenant d'autres collègues d'une manière plus indirecte. Les acteurs captent des informations nécessaires à leurs performances en provenance d'autres sources sans que celles-ci s'en aperçoivent. Ce type d'action intègre plusieurs mécanismes comme *la conscience situationnelle (situated awareness), l'imitation, la supervision mutuelle (mutual monitoring),...*

A l'issu de cet observation, nous souhaitons formaliser les éléments ressources ou bloquant (favorisant ou inhibant) la coordination. Parmi ces éléments, nous porterons un regard particulier sur les suivants :

- *La technologie* : comprendre comment les acteurs utilisent la technologie et comment cette dernière affecte leurs actions communicatives.
- *Les règles de coordination*: comprendre les interdépendances et les séquences entre les actions (exemple l'étape A doit être achevée avant l'étape B)
- *La culture* : Il s'agit d'identifier les normes et les valeurs pour chaque situation et pour chaque action communicative.

Le tableau suivant synthétise l'objectif de notre étude dans l'entreprise.

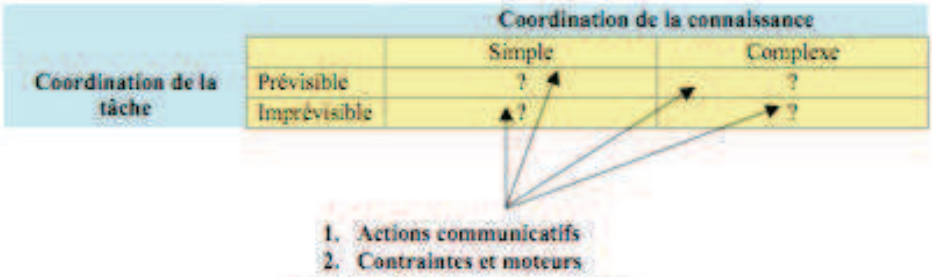


Tableau 2 Synthèse de notre étude

III. Le guide d'entretien (format Basique)

Nous allons démarrer chaque entretien par une question ouverte suivante :
Pouvez-vous me décrire les étapes du processus d'affectation d'un technicien à un dépannage ?

L'objectif est d'identifier chacune des séquences (définies comme des moments d'action et de décisions) pour en extraire :

1. Les objectifs de chaque séquence.
2. Les événements et les actions qui la constituent.
3. Les critères sur lesquels sont prises les décisions.
4. Les ressources/supports à l'aide à la décision (Interactions entre les actions communicatives visibles et invisibles)
5. Les contraintes d'aide à la décision (technologie, règles de coordination, environnement institutionnel et culture)

Les résultats de cette recherche seront intégrés dans le tableau de synthèse présentés ci-dessous. Il permettra de :
- Formaliser les bonnes pratiques mobilisés par les acteurs en situation de crise
- Aboutir à la construction d'outils repérant les bonnes pratiques notamment les pratiques informelles difficiles d'écrire sous la forme d'algorithme de travail (fiche de poste, référentiel de compétence, processus, etc.)
- En lien avec le thème précédent, faciliter la formation et l'intégration des nouveaux entrants
- Proposer des pistes aux entreprises pour la gestion sociale des impacts (rémunération, classification, carrière, mode d'évaluation, etc.) liés à la reconnaissance de cette « compétence » informelle.

7

Annex 5. Internship agreement

france telecom

CODFOR : 02140 / JR4

CONVENTION DE STAGE A CARACTERE OBLIGATOIRE

STAGE NON INDEMNISE	☒
STAGE AVEC GRATIFICATION :	☐ ≤ à 398,13 euros (seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h)
	☐ > à 398,13 euros (seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h).

Article 1 : Les contractants

La présente convention règle les rapports entre France Télécom représentée par Madame Madeleine JACQUART, Directrice de l'UI Alpes.

Et

Université Pierre Mendès France/CERAG Grenoble, 151 rue des Universités BP 47 38040 GRENOBLE CEDEX 9, représenté(e) par Monsieur Alain SPALANZANI, Président.

Elle concerne Monsieur Khoubeib DJEMAI, domicilié 8 rue Guillaume Apolinaire 38400 ST MARTIN D'HERES, étudiant, régulièrement inscrit dans l'établissement d'enseignement.

La signature du stagiaire apposée ci-après atteste qu'il a pris connaissance des clauses de la présente convention et y consent expressément.

Article 2 : Le stage

Le stage a pour objet essentiel d'assurer dans un service de France Télécom l'application pratique de l'enseignement dispensé lors de la préparation du diplôme suivant : Doctorat en Management des Systèmes d'information.

Il portera sur le programme suivant :
Réalisation d'une étude de terrain dans une netreprise utilisant des technologies avancées de communication entre le centre de contrôle et les techniciens..

- Il se déroulera du 1er février 2010 au 26 février 2010 au sein de : UI ALPES, 39 RUE JOSEPH CHANRION 38000 GRENOBLE.
Il aura une durée hebdomadaire maximale de 35H00.

- Sous l'autorité de Monsieur Jean Luc GAY, Directeur du Département Conduite d'Activités et de Monsieur Marc FAVIER, Professeur.
Dans la mesure où la poursuite de sa scolarité l'exige, le stagiaire pourra revenir dans l'établissement d'enseignement pendant la durée du stage sans pouvoir prétendre à une quelconque prise en charge ou indemnisation. Il est tenu d'en informer au préalable le responsable du stage.

Article 3 : Indemnisation- Gratification

Un montant minimal de rémunération est dû pour tout stage d'une durée supérieure à ~~3 mois~~ 2 mois consécutifs (~~selon l'article 9 de la loi du 31 mars 2006~~). selon §90.

Cocher la case correspondant à la situation du stagiaire :

☒ Stage non indemnisé

☐ Gratification inférieure ou égale à 398,13 euros
(seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h).

☐ Gratification supérieure à 398,13 euros.
(seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h)

Article 4 : Déroulement du stage

Pendant la durée du stage, le stagiaire demeure sous statut scolaire. Il reste sous l'autorité et la responsabilité du chef de l'établissement scolaire.

Le stagiaire n'étant pas salarié de France Télécom, il ne peut prétendre aux congés payés.

Il ne doit pas être pris en compte pour l'appréciation de l'effectif de l'entreprise et ne peut participer à une quelconque élection professionnelle.

Le stagiaire est soumis au règlement intérieur en vigueur dans le service qui l'accueille, notamment en ce qui concerne les horaires, la sécurité, la discipline. En cas de manquement, le représentant de France Télécom, se réserve le droit de mettre fin au stage après avoir prévenu le directeur de l'établissement d'enseignement.

Le stagiaire a accès dans les mêmes conditions que les salariés de France Télécom, aux restaurants d'entreprise.

Le tuteur dans l'entreprise est chargé d'accueillir le stagiaire, de l'encadrer, et de l'accompagner durant le stage.

Le tuteur ainsi que le responsable de stage nommément désignés à l'article 2, s'engagent à être joignables pendant la durée du stage ainsi qu'à faire un point d'étape avec le stagiaire au cours du stage.

Article 5 : Couverture sociale – Accidents du travail – Absences

Le stagiaire est tenu d'être en règle vis à vis de la Sécurité Sociale. Le cas échéant, il souscrira une assurance complémentaire de type mutualiste.

Lorsque le stagiaire perçoit une gratification inférieure ou égale à 398,13 euros (seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h), celle-ci est exonérée des cotisations et contributions sociales. Le risque accident du travail est assuré par l'établissement d'enseignement.

Lorsque le stagiaire perçoit une gratification supérieure à 398,13 euros (seuil de franchise de cotisations pour l'année en cours pour un temps plein 35h), la partie supérieure à ce seuil est soumise aux cotisations sociales patronales et salariales. France Télécom prend en charge le risque accident du travail.

En application des dispositions des articles L.412-8 2a, R.412.4, L.441-2 du code de la Sécurité Sociale, les stagiaires bénéficient de la législation sur les accidents du travail.
En cas d'accident survenant à l'élève stagiaire, au cours de ses activités de stage (déplacements inclus) ou au cours du trajet, l'obligation de déclaration d'accident incombe à l'entreprise et le représentant de France Télécom, mentionné à l'article 1, s'engage à adresser sans délai au Directeur d'établissement copie de la déclaration d'accident envoyée à la caisse primaire de Sécurité Sociale compétente.

En cas d'absence, le stagiaire doit aviser dans les 24 heures ouvrables les responsables de stage respectivement de l'établissement d'enseignement et de l'entreprise.
Toute absence du stagiaire doit être justifiée et validée par le tuteur et motivée par des circonstances exceptionnelles.
Le chef d'établissement et le représentant de l'entreprise se tiendront mutuellement informés des difficultés (notamment dues aux absences du stagiaire) qui pourraient naître de l'application de la présente convention et prendront d'un commun accord et en liaison avec l'équipe pédagogique, les dispositions propres à les résoudre, notamment en cas de manquement à la discipline. Le stage pourra être suspendu en cas de manquement à la discipline et au règlement intérieur. Il pourra être résilié en cas d'absences injustifiées et de manquements particulièrement graves à la discipline.

Article 6 : Responsabilité

Le chef d'entreprise prend les dispositions nécessaires pour garantir sa responsabilité civile chaque fois qu'elle sera engagée :

- soit en souscrivant une assurance particulière garantissant sa responsabilité civile en cas de faute imputable à l'entreprise à l'égard du stagiaire;
- soit en ajoutant à son contrat déjà souscrit «responsabilité civile entreprise» ou «responsabilité civile professionnelle» un avenant relatif au stagiaire.

Le chef d'établissement contracte une assurance couvrant la responsabilité civile de l'élève pour les dommages qu'il pourrait causer pendant la durée ou à l'occasion de son stage en entreprise (uniquement pour les stages conventionnés).

Lorsque la responsabilité de France Télécom sera engagée à l'égard d'un tiers du fait du stagiaire, le cas sera traité par France Télécom comme s'il s'agissait de l'un de ses agents.

France Télécom se réserve le droit de réclamer au stagiaire (ou à son représentant légal) les sommes qui auraient été versées au-dit tiers à la suite d'une faute intentionnelle ou inexcusable commise par le stagiaire.

Article 7 : Rapport de stage

Si le stagiaire doit fournir un rapport à l'issue de son stage, il sera obligatoirement soumis au représentant de France Télécom avant transmission à l'établissement d'enseignement.
Le représentant de France Télécom remettra au stagiaire en fin de stage, une attestation indiquant le sujet, le lieu, la durée du stage ainsi qu'une appréciation sur le déroulement du stage.

Article 8 : Confidentialité et propriété industrielle

Confidentialité : le stagiaire est soumis à l'obligation absolue de secret professionnel. En particulier, il ne pourra transmettre à aucun tiers, et sous quelque forme que ce soit, sans accord préalable écrit du représentant de France Télécom, les savoir-faire, documents, résultats d'études, dossiers, logiciels, maquettes, procédures d'accès... qu'il serait amené à élaborer ou dont il prendrait connaissance dans le cadre de l'exécution de son stage.

Après approbation par le représentant de France Télécom, le rapport de stage sera considéré comme propriété du stagiaire et ne sera pas soumis aux règles ci-dessus, sauf d'éventuelles parties confidentielles qui devraient alors être regroupées dans une annexe séparable.

De même, toute publication dans une revue scientifique ou technique, ou toute autre publication à caractère non confidentiel, faite après accord préalable du représentant de France Télécom pourra être diffusée sans restriction par le stagiaire.

Propriété industrielle : La propriété industrielle des résultats (brevetables ou non) des études auxquelles le stagiaire participera au cours du stage, revient de plein droit à France Télécom qui en a la libre disposition.
Le dépôt éventuel d'un ou plusieurs brevets, liés aux dispositifs mis au point par le stagiaire au cours de son stage, sera effectué par les services compétents au nom et aux frais de France Télécom. Le nom de l'inventeur sera mentionné sur la demande de brevet et la rémunération correspondante sera versée au-dit inventeur suivant les règles en vigueur à France Télécom.

Fait en trois exemplaires,

A Grenoble
Le 10 février 2010

Le Représentant de France Telecom	Le Stagiaire	Le Représentant de l'Etablissement
Madame Madeleine JACQUART	Monsieur Khoubeib DJEMAI	Monsieur Alain SPALANZANI
	(«lu et approuvé »)	(«lu et approuvé »)

UNIVERSITÉ PIERRE MENDÈS FRANCE
Le Président
GRENOBLE II

TABLE OF CONTENTS

UNIVERSITE DE GRENOBLE

The impact of Field Force Automation on coordination: The cases of intervention technicians of France Télécom

Abstract

The aim of this thesis is to explore a new emerging technology, now gaining success in organization, called Field Force Automation (FFA) that belongs to an ever-widening, area called the Mobile Business (M-Business), a term that encompasses all kinds of mobile applications addressed to companies. This success is mainly related to its capacity for connecting Field workers, like technicians, the Fire Brigade, truck drivers and many others to corporate organizations. These workers were previously working in disconnected mode, but can now access, collect and process data remotely and in real-time. As a result, this new way of technological connectivity allows companies to increase their performance by increasing technician productivity and reducing travel-related costs.

However, despite these advantages, its use is problematic, especially for the communities of technicians because its implementation implies fundamental changes of their work context, particularly concerning coordination. Before the use of these technologies, technicians went to the central station in order to get their workload. However, with the use of this technology, they can start working directly from home. In doing so, organizations applied a positive technical change but overlooked the human dimension, more precisely the collaboration between the technicians, which increases efficiency at work by exchanging experiences, discussing problems and solutions and the usual friendly interaction which gives team cohesion. According to the socio-technical approach, missing this social structure in the implementation of this new technology condemns it to failure.

It is through this observation that this research project has taken shape with the aim of exploring how and why accentuating the technical dimension at the expense of the social one leads to the failure of the Information Systems (IS) innovation and decreases the overall performance of the organization in question.

To analyze this problematic we applied a socio-technical theory, applied to organizational change because it argues that technical change alone can negatively impact the work performance whereas socio-technical change can impact an organization's performance positively.

Multiple-case design is required to compare these two cases and confirm or refute the above theory. France Télécom was the company selected because those types of change could be observed separately and subsequently compared. The results of this research take the form of concrete examples from the real world of what we can call technical and socio-technical change.

Keywords: M-business, FFA, coordination means, organization change, Information technology, telecommunication, technical change, socio-technical change, field workers, communities of practice

L'impact des technologies d'automatisation des collaborateurs de terrain sur la coordination: les cas des techniciens d'intervention de France Télécom

Résumé

L'objectif de cette thèse est d'explorer une nouvelle technologie qui remporte un certain succès dans les organisations de service connue sous l'appellation Field Force Automation (FFA). Cette technologie appartient à un vaste domaine émergent, les applications professionnelles mobiles (M-Business). Ce terme englobe tous les types d'applications mobiles destinés aux entreprises ; son succès est principalement lié à sa capacité à relier à l'entreprise, les collaborateurs de terrain (par exemple, les techniciens, les pompiers, les chauffeurs routiers etc.) qui travaillaient préalablement sans liaison directe avec leur base. L'utilisation de ces technologies, permet à ces travailleurs d'accéder à, de collecter et de traiter des données à distance et en temps réel. Le fait de connecter les collaborateurs mobiles permet à l'entreprise d'accroître sa performance, en augmentant la productivité des techniciens tout en réduisant les coûts liés aux déplacements.

Malgré tous ces avantages, l'utilisation de cette technologie pose des problèmes aux communautés de techniciens, plus particulièrement ceux qui subissent des changements fondamentaux dans leur mode de travail, car cette technologie a profondément modifié la manière dont ils coordonnent leur travail. En effet, avant l'utilisation de ces technologies, les techniciens se rendaient à la station centrale afin d'obtenir leur charge de travail. Ils doivent maintenant partir en intervention directement de leur domicile. Les organisations ont appliqué un changement technique, mais ont mal pris en compte l'impact de ce changement sur la structure sociale. Notamment le fait que les techniciens ne se rendaient pas à la station centrale uniquement pour obtenir leur charge de travail mais aussi pour y échanger leurs expériences, discuter des problèmes rencontrés et des solutions apportées accroissant ainsi l'efficacité de leur travail. Selon l'approche sociotechnique, le manque d'attention à la structure sociale dans l'application de cette nouvelle technologie condamne à l'échec ces technologies au niveau des organisations qui ne prendraient pas en compte cette dimension.

Ce phénomène est à l'origine de ce projet de recherche. Cette recherche a pour but d'explorer comment et pourquoi le fait de se concentrer sur la dimension technique peut mener l'implantation de ces technologies à l'échec et impacter négativement la performance des organisations. Pour analyser cette problématique, nous avons appliqué une approche sociotechnique afin d'étudier le changement organisationnel, car cette approche se base sur deux propositions majeures: le changement technique seul impacte négativement la performance de l'organisation et le changement sociotechnique impacte positivement la performance de l'organisation.

Afin d'examiner et comparer ces propositions, un design de cas multiples est nécessaire pour les confirmer. L'entreprise France Télécom correspond à ce design de recherche, sollicitée elle a accepté de m'accueillir pour effectuer cette recherche. L'observation de cas au sein de cette organisation nous permet d'identifier et de comparer plusieurs exemples concrets reflétant le changement technique et ce que nous appelons le changement sociotechnique.

Mots-clés: M-business, FFA, modes de coordination, changement organisationnel, les technologies de l'information, les télécommunications, les changements techniques, les changements sociotechniques, les collaborateurs mobiles, les communautés de pratiques